CONCEPTUAL DESIGN REPORT

FINAL

December 29, 2020

RURAL POWER SYSTEM & BULK FUEL UPGRADES

Venetie, Alaska

Prepared for:

ALASKA ENERGY AUTHORITY

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Executive Summary

This report has been prepared by CRW Engineering Group LLC. for the Alaska Energy Authority (AEA). The purpose of this report is to provide a concept design and construction cost estimate for the following potential local energy projects for the community of Venetie:

- Diesel Power Plant Replacement
- Heat Recovery System Upgrades
- Bulk Fuel Storage Upgrades
- Electric Distribution Upgrades

Participants in the project include the Village of Venetie which owns the Venetie Electric Utility and bulk fuel storage / retail dispensing facilities, and the Yukon Flats School District which operates a bulk fuel tank farm and emergency backup generator at the school.

On October 7, 2020, a site visit was performed by Bill Price (AEA), Dave Messier (Tanana Chiefs Conference), Tyler Keene and Karl Hulse (CRW Engineering Group), and John Dickerson (Gray Stassel Engineering. The purpose of this site visit was to meet with local officials as well as representatives of local and regional organizations to identify and discuss the proposed power system and bulk fuel upgrades and gather field data on the community's existing energy infrastructure and inspect the proposed power plant and tank farm sites.

The existing power plant is situated adjacent to the existing washeteria/water treatment plant (washeteria) and was reportedly constructed in the early 1990s. The 20'x30'wood-framed structure rests on a steel post and pad foundation (steel pads are situated on a thin concrete slab poured directly on the ground surface). The facility includes three gen sets: Two John Deere 6081's rated at 180 kW each at 1,800 rpm and a John Deere 6068 rated at 125 kW at 1,800 RPM. The gen sets are in poor condition and the switchgear is old and obsolete. The building is in poor condition with inadequate lighting and ventilation, and oil soaked interior and exterior walls. Further, the foundation system appears to have settled and extra post supports have been added to level the structure. Due to the age, size, and poor condition of the existing building and the runtime hours on the existing gensets, it is recommended that the power plant be completely replaced with a new power plant.

The community's existing electrical distribution system is fed via three, single-phase, pole-mount 75 kVA step up transformers located adjacent to the power plant. The step up transformers connect to an overhead (7200/12470) distribution system, which supplies the village. The majority of the distribution system is single phase with 3-phase service limited to central town and the school. The majority of the distribution system is in excess of 30 years old and has exceeded its intended design life. Further, the community load is not properly balanced between phases, causing wear on the gen sets and frequent outages due to circuit breaker trips.

Venetie receives all bulk fuel deliveries via air tanker. The Utility maintains a 5,300-gallon, skid-mounted tank at the airport for temporary staging of delivered fuel. Everts Air Cargo is the primary fuel supplier; their air tanker has a carrying capacity of 4,400 gallons. The average utility diesel fuel usage is reportedly 4,000 gallons

per month, requiring fuel deliveries every three to four weeks. In practice, deliveries occur more often to accommodate school and residential heating and retail fuel sales demands. The Village transfers fuel from the airport storage tank to the power plant intermediate tank on an as-needed basis using an improvised tanker truck (single wall tank strapped into a dump truck bed). The same tank is also used to transport gasoline from the airport to the retail fuel dispensing facility at the village store. The school owns an old, 5,000-gallon military fuel truck that they utilize to transport fuel from the airport to the school tank farm on an as needed basis.

The proposed new power plant site is north of the existing power plant and southeast of the planned Central Sanitation Building which is scheduled for construction in summer 2021 by ANTHC. The new power plant building will be a wood framed structure with a welded steel floor structure and an adjustable beam and pad type foundation. The plant will have a generation room containing three generators and associated mechanical equipment and a control room which will contain programmable automatic paralleling switchgear and SCADA equipment. Other features of the new plant include a fire suppression system, critical grade silencers, and heat recovery. Fuel for the power plant will be piped from a new, 8,000-gallon, double wall intermediate tank located adjacent to the power plant.

The proposed heat recovery system will capture jacket water heat from the diesel generators using a heat exchanger. It will deliver heat to the existing washeteria building and clinic upon commissioning. The system will also include connections to tie into the future Central Sanitation Facility with a possible branch to the renovated BIA facility when completed. Based on preliminary energy calculations, the proposed heat recovery system could displace up to 17,000 gallons of heating fuel annually if all of four of these end user facilities were eventually connected.

Power is currently generated at 480 volt, 3-phase, and distributed at 12.47/7.2 kVA 3-phase with primarily above grade construction. The existing power system is severely unbalanced. Existing transformers and meter bases are moderately to severely corroded, and an insufficient quantity of distribution transformers creates low voltage at some services. With the exception of the single phase circuit to the airport and a few sections of distribution recently upgraded near the school, the entire electrical distribution system should be replaced to improve efficiency and reliability, reduce operating costs, and to meet the long term electric power needs of the community.

Proposed bulk fuel upgrades include a new tank farm for the Village of Venetie located at the airport with two 8,000-gallon double wall Above Ground Tanks (AST) for diesel storage and one 5,000-gallon double wall AST for gasoline storage. The tanks will be configured for transport via C-130 aircraft and will be filled via a new dual product airplane header and 3” diameter welded steel fill pipelines. During final design, consideration will also be given to the use of single wall tanks within a lined earthen containment dike. The final decision regarding containment will be based on comparative cost analysis and community preference.

A truck fill secondary containment area and truck fill header will be installed adjacent to the new t airport tank farm. Submersible pumps in each bulk tank and

welded steel fill pipelines will facilitate filling of a village-owned fuel tanker truck, which will then transport the fuel to intermediate and end use tanks within the community. A new, 3,000-gallon, dual product dispensing tank with an integral two-product retail dispenser will be located adjacent to the village office for retail sale of diesel and gasoline. Intermediate tanks at the power plant, clinic, etc. will be filled via the community fuel truck.

The AEA is still in preliminary discussions with the regional school district (Yukon Flats School District) regarding potential project participation. Based on discussions to date, the District is interested in installing two 8,000-gallon double wall ASTs for diesel storage north of the existing school building. The new tanks would be filled via the school's existing tanker truck (no infrastructure would be required at the airport). Further, the facility would be connected to existing steel piping feeding an existing interior day tank in the school mechanical room.

We understand that funding for final design and construction is pending additional input from AEA and the Denali Commission. The schedule below assumes that funding for final design will be released by February 2021 and construction funding will be available for power plant, heat recovery, and bulk fuel improvements by June 2021. A schedule for the proposed electrical distribution improvements is not provided in the CDR as we understand these improvements will be accomplished in phases subject to future funding availability.

Proposed project schedule:

- December 2020 / January 2021: Finalize CDR
- February 1 2021: Receive design NTP for power plant, heat recovery, and bulk fuel scope items.
- June 1, 2021: Submit final design / bid documents
- June 2 – July 14: Advertise, receive bids, protest period, award contract. Recommended contract completion date October 2022
- Summer / Fall 2021: Contractor mob, Power Plant and Tank Farm site work / foundation preparation. Coordinate with ongoing ANTHC Sanitation Facility project.
- Fall 2021: Complete submittal review
- Winter 2021 / 2022: Winter shutdown on site. Contractor to complete project material procurement / buy out.
- Spring 2022: Contractor Remobilization
- Summer 2022: complete power plant, recovered heat and tank farm work.
- Fall 2022: Power Plant Testing, Start Up, and System Commissioning
- Winter 2022: Record Drawings, O&M Manuals, Project Closeout

A summary of the estimated total construction costs is provided below, including all contractor provided labor, materials, equipment, freight, contractor overhead and profit, and a 15% contingency:

$2,500,091	**Power Plant Upgrade (Including Ph 1 Heat Recovery)**
$ 94,500	**Heat Recovery Phase 2 (Central Sanitation Building)**
$ 146,063	**Heat Recovery Phase 3 (BIA Facility)**
$1,495,025	**Village of Venetie Bulk Fuel Tank Farm))**
$ 483,338	**Yukon Flats School District Bulk Fuel Tank Farm)**
$1,492,678	**Power Distribution Upgrades**
$6,211,696	**TOTAL COST ALL PROPOSED ENERGY PROJECTS**

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1.0 INTRODUCTION

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- Heat Recovery System Upgrades
- Bulk Fuel Storage Upgrades
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Participants in the project include the Village of Venetie which owns the Venetie Electric Utility and bulk fuel storage / retail dispensing facilities, and the Yukon Flats School District which operates a bulk fuel tank farm and emergency backup generator at the school.

1.1 Program Overview

The Alaska Energy Authority (AEA), Rural Energy Group is pursuing grant funds to upgrade rural bulk fuel tank farms and electric power systems. All project components are dependent on available funding. Following is a brief outline of the program:

- Funding for the project is a combination of State and Federal grants. In order to receive grant funds, each community must demonstrate the proposed facility will be sustainable by accepting a business plan. The business plan describes who owns the facility, and how it will be operated, maintained and replaced.
- New energy projects are funded, designed, and constructed in three phases: Phase 1, Conceptual Design; Phase 2, Final Design and Permitting; and Phase 3, Construction.
- During Phase 1, Conceptual Design, staff from AEA will visit a community, discuss the program, and work with project stakeholders and the local government to select sites for the new facilities.
- At the completion of Phase 1 Conceptual Design, the community will be requested to review and approve the location, capacity, and basic configuration of the facilities.
- During Phase 2, Final Design and Permitting, the design and permitting for the energy projects will be completed, as well as a business operating plan. A project level environmental assessment will be prepared and site control documented.
- Each community will be requested to provide “in kind” contributions as available.
- Training Available: AEA has several training programs available for communities.

1.2 Community Description

Venetie is located on the north side of the Chandalar River, 45 miles northwest of Fort Yukon. It lies at approximately 67.0167 North latitude and 146.4218 West longitude. Venetie falls within the continental climate zone, characterized by extreme temperature differences. The continental climate zone encompasses most of the central part of the state and experiences extremely cold winters and warm summers. The Chandalar River is ice-free from the end of May through mid-September.

LOCATION MAP

1.3 Site Investigation

On October 7, 2020, a site visit was performed by Bill Price (AEA), Dave Messier (Tanana Chiefs Conference), Tyler Keene and Karl Hulse (CRW Engineering Group), and John Dickerson (Gray Stassel Engineering). The purpose of this site visit was to meet with local officials as well as representatives of local and regional organizations to identify and discuss the proposed power system and bulk fuel upgrades, gather field data on the community's existing energy infrastructure, and inspect the proposed power plant and tank farm sites.

In addition to the data gathered during the site visit, available information was obtained and analyzed from the following sources:

- Venetie Power Cost Equalization (PCE) Data, 2015-2019
- Venetie Airport Layout Plan, 2005
- State of Alaska, Dept. of Commerce, Community and Economic Development, Community & Regional Affairs Community Profile & Mapping
- Corps of Engineers wetlands and flood information
- Alaska Dept. of Environmental Conservation Contaminated Site Data Base
- Other relevant data.

Additional information and input was obtained from the following individuals:

- Eddie Frank, Venetie First Chief 907-849-8212
- Clayton Tackett, Council Member 907-849-8212
- Patrick Zettler, FAA AK Region Lead Civil Engineer 907-271-5446
- Vickie Swain, ADOT Aviation Leasing 907-269-0745
- Tony Peters, Yukon Flats School District 907-371-8553

1.4 Code Analysis & Deficiencies

The concept design has been prepared to meet current code and regulatory requirements, which include:

- The 2012 Edition of the International Building Code (IBC).
- The 2012 Edition of the International Fire Code (IFC) and currently adopted Alaska State Fire and Safety Regulations.
- The 2014 Edition of the National Electrical Code (NEC, NFPA 70).
- The 2012 Edition of the National Electrical Safety Code (NESC).
- 40 CFR, Part 112.1-12, U.S. Environmental Protection Agency Spill Prevention Requirements

The following is a summary of existing power plant, electrical distribution system and bulk fuel storage and dispensing systems code analysis and deficiencies observed during the site investigations.

Power Plant

- Gensets are at or near the end of their useful lives
- Antiquated switchgear does not support auto start/stop and paralleling.
- No peak demand meter
- No operational fire suppression system
- Building has inadequate lighting and ventilation
- Interior and exterior walls are oil-soaked
- Foundation appears to have settled
- No door locks and inadequate security fencing

Electrical Distribution System

- Most existing poles and conductor are in excess of 30 years old and show severe weathering/splitting.
- Many transformers are supplying excessive service connections causing low voltage at services.

- Broken poles and non-standard wood poles (driftwood poles).
- Multiple overhead clearance violations.
- System is not properly balanced (C phase has 2-3 times more load than other phases).

Bulk Fuel Storage and Dispensing Systems

- No secondary containment at airport storage facility
- No security fence.
- Non-code compliant airplane header and fuel transfer systems.
- Non-code compliant fuel transport system (single wall tank in dump truck bed).
- Dispensing tanks are not fire-rated.
- Non code compliant wiring at retail dispensing facility

2.0 EXISTING FACILITIES

The Venetie Village Electric system is owned and operated by the Village of Venetie, pursuant to Certificate of Public Convenience and Necessity (CPC&N No. 663). Community electric power is provided by a diesel electric power plant. The existing power plant and electric distribution system were visually examined to determine suitability for re-use. The following paragraphs summarize findings for the community.

2.1 Power Plant

The existing power plant is situated adjacent to the washeteria and was reportedly constructed in the early 1990's. The 20'x30' wood-framed structure rests on a steel post and pad foundation (steel pads are situated on a thin concrete slab poured directly on the ground surface). The facility includes three gensets: Two John Deere 6081's rated at 180 kW each at 1,800 rpm and one John Deere 6068 rated at 125 kW at 1,800 RPM. The gensets are in poor condition and the switchgear is old and obsolete.

Engine cooling is via two remote interior radiators located in a separate room off the generator bay. Power is generated at 480V 3-phase with a pole mounted step-up transformer bank adjacent to the power plant for the 7.2kV/12.47kV distribution. Station service is provided at 120/208V 3-phase. The manual switchgear was provided by Controlled Power Inc and includes a section for each generator, and a master section.

The building is in poor condition with inadequate lighting and ventilation, and oil-soaked interior and exterior walls. Further, the foundation system appears to have settled and extra post supports have been added to level the structure.

2.2 Electrical Distribution

The electrical distribution system is 12.47/7.2kVA, 3-phase system fed via three, single-phase, pole-mount 75 kVA step up transformers located adjacent to the power plant. The step up transformers connect to an overhead (7200/12470) distribution system, which supplies the village. The majority of the distribution system is single phase with 3-phase service limited to central town and the school area. The majority of the distribution system is in excess of 30 years old and has exceeded its intended design life. Further, the community load is not properly balanced between phases. The power plant operator indicated that the community has experienced multiple power outages when the runway lights come on due to an approaching aircraft even though the total community load was well below the capacity of the running generator. These events have occurred when operating on the existing 180kW unit. This situation will be addressed in the new distribution design by extending the 3-phase distribution further toward the airport and/or by moving community loads to other phases to take load off the airport extension. If the new power plant is completed prior to distribution system upgrades, rebalancing of the existing system may be required prior to bringing the new power plant on line to avoid overload conditions on one or more phases.

2.3 Fuel Storage Handling and Dispensing Systems

Venetie receives all bulk fuel deliveries via air tanker. The Utility maintains a 5,300-gallon, skid-mounted tank at the airport for temporary staging of delivered fuel. Everts Air Cargo is the primary fuel supplier; their air tanker has a carrying capacity of 4,400 gallons. The Village transfers fuel from the airport storage tank to intermediate tanks located at the power plant, clinic, and other village owned facilities on an as-needed basis using an improvised tanker truck (single wall “fuel-cube” tank strapped into a dump truck bed). The same tank is also used to transport diesel and gasoline from the airport to the retail fuel dispensing facility at the village store. The school owns an old, 5,000-gallon military fuel truck that they utilize to transport fuel from the airport to the school tank farm on an as needed basis. The school fuel tank truck is reportedly filled directly from the air tanker.

The power plant intermediate tank consists of a 1,500-gallon skid mounted horizontal double wall AST located adjacent to the power plant building. The intermediate tank is filled through a top threaded penetration via a rubber hose and camlock couplings. A 2-inch diameter steel pipeline with threaded and flanged joints runs above grade from the intermediate tank to an auto fill day tank inside the power plant. All 3 generators are fed directly from the day tank.

2.4 Heat Recovery System

The washeteria and clinic are currently served by diesel generation heat recovery from the existing power plant. A pair of 2" PEX arctic pipes run above grade a short distance from the power plant to the washeteria. Heat recovery equipment located at the washeteria includes the main circulation pump, expansion tank, and a brazed plate heat exchanger for hot water production and water treatment pre-heat.

The 2015 ANTHC clinic heat recovery project added a buried 2" PEX arctic pipe secondary loop to the clinic that connects downstream of the washeteria heat exchanger. Clinic heat recovery equipment was installed in the washeteria boiler room, in a wooden "doghouse" adjacent to the washeteria, and in the clinic boiler room.

Clinic heat recovery equipment located at the washeteria boiler room and "dog house" includes the secondary loop main circulation pump, instrumentation, and the clinic heat recovery control panel. The control panel monitors the temperature, pressure and flow rate in the secondary loop as well as the temperature in the heat recovery return main. The control panel turns off the secondary loop pump when the main temperature drops below a set point. During the site visit it appeared that the heat recovery system at the washeteria was functioning properly with the exception that system pressure was lower than expected (less than 10 psi). Additional glycol should be added to the system to increase pressure. The annual fuel use of the existing washeteria and clinic is unknown.

Clinic heat recovery equipment located at the clinic includes a brazed plate heat exchanger, pump for heat exchanger secondary loop, differential temperature controller and BTU meter. The temperature controller turns of the pump if the building return temperature is hotter than the heat recovery supply temperature or if the heat recovery supply temperature drops below a set point.

A portion of the existing heat recovery system will remain in service as part of the new power plant generation heat recovery system. See Section 4.2 for a description of the proposed new generation heat recovery system.

3.0 COMMUNITY POWER DEMAND

A review of Venetie PCE data from FY15 through FY20 revealed missing and reported anomalies in FY18 "diesel kWh generated" data for the months of December, January and February. There also is missing FY18 fuel use data for the months of January and February. An average of the reported months was used to estimate data for the missing months. After applying correction factors to the FY18 kWh generated data, the total power generation in FY18 was approximately 639,275 kWh. Total diesel fuel used in FY18 was approximately 64,859 gallons. The below table shows kWh generated, gallons of fuel used, average kW demand, average kWh generated/month, and peak kW demand. PCE data for FY15 through FY20 is included in Appendix D.

Fiscal Year	Total kWh Generated	Fuel Used (Gallons)	Average demand (kW)	Average kWh Generated/ Month	Estimated Peak Demand (kW)	Total kWh Generated & Fuel Use Notes
FY15	592,700	65,495	68	49,392	102	
FY16	683,200	80,675	78	56,933	117	
FY17	680,200	62,494	78	56,683	117	
FY18	639,275	64,859	73	58,116	110	Estimated
FY19	730,400	87,201	84	60,867	126	
FY20	750,100	67,824	86	75,010	129 (recorded)	

To evaluate power quality and monitor system power factor, a portable recording power meter was installed by others at the power plant with readings starting on October 22, 2019. A Peak Demand of 129kW was recorded in January of 2020. In the above table the peak demand was estimated by multiplying the average load by 1.5 which appears to correlate well with the recorded peak.

3.1 Estimated Future Load Growth

It is important to evaluate the impact of planned infrastructure improvement projects on an existing power generation system. New construction and other community improvements can adversely impact the adequacy of existing facilities.

The community profile data indicates that the population of Venetie has increased slightly from 166 in 2010 to 174 as of 2018. It is anticipated that community winter loads will remain relatively constant or grow slightly over the next several years.

Based on discussions had with the community during the site visit, there are two known projects planned for Venetie in the near future that could potentially impact the electric loads. The first project is the new ANTHC Central Sanitation Facility which will replace the existing washeteria. The second project is the renovation of portions of the existing BIA school structures into office space.

The electric demand of the existing washeteria is unknown, however the facility is approximately 1,600-sq.ft building. The existing facility contains three washers, three dryers, showers, restrooms, and water treatment pumps and equipment.

The new sanitation facility will be a 2,268-sq.ft wood framed building containing laundry and plenum rooms, office, four restrooms, two showers, boiler room, and water treatment room. The new facility will be equipped with two diesel fired boilers for heat and domestic hot water. New heat exchangers will be included in order to tie into the heat recovery system. Six washing machines and three double stacked dryers will be provided. The dryers will be equipped with preheat and drum heat coils from the building hydronic system. It is estimated that when the new sanitation facility replaces the old washeteria it will add 10kW to the community peak load and 5kW to the average load. This estimate assumes that the old washeteria will have minimal electric demand for lighting and equipment after it is decommissioned and converted to shop or storage space.

The Village is proposing to renovate portions of an existing unused BIA building into office space. It is estimated that the 3,000-sq.ft. building which was constructed circa 1950, would add approximately 5kW to the average community load for lighting and equipment. This estimate assumes no large electric range/oven or electric heat is used.

Considering the historic trends and available infrastructure upgrade information, it is expected that both the average and peak electric loads will gradually increase with peak loads approaching 150 kW within a few years.

3.2 Alternative/Renewable Energy

Feasibility studies have been performed for alternative/renewable energy sources in the vicinity of Venetie, including geothermal, hydroelectric, solar, and wind.

In 2012, the Department of Energy commissioned Sandia National Laboratories to provide an assessment of the electrical power system in Venetie. Venetie is located in a region with few renewable energy resources available[1].

Except for the proposed diesel generation heat recovery and potential end-use conservation within the village, there are no other practical energy options currently available at Venetie. The new diesel power plant will be designed to incorporate and integrate alternative/renewable resources should a renewable project be developed in the future.

The below sections summarize prior renewable energy options.

3.2.1 Heat Recovery

See Section 2.4 for a description of the existing diesel generation heat recovery system and see Section 4.2 for a description of the proposed new heat recovery system.

3.2.2 Efficiency Improvements

The Yukon Flats School District published a request for proposal for the Project Management portion of a project to design and execute renovations to the Venetie School. The proposed schedule has the design/planning phase beginning in February of 2021 with renovation starting in June of 2021.

A 2019 Existing Conditions Assessment report by Bettisworth North identified several renovations required for the school. Many of the renovations are anticipated to improve the energy efficiency of the school and include new siding and roofing, flushing of the hydronic system, replacing the boilers, hydronic pumps, piping insulation, heat controls and thermostats, and new ventilation heating coils. Ventilation is to be improved in some areas of the school with the addition of properly sized air handling units. The project will also replace the existing electrical service equipment and standby generators switchgear. Renovations also call for energy efficient long-lasting LED fixtures throughout the school.

[1] Sandia National Laboratories. **Venetie, Alaska Energy Assessment**. Albuquerque, New Mexico. Sandia National Laboratories, July 2013. 13.

No information on any other energy efficiency assessments was discovered during this study.

3.2.3 Geothermal

There are no known geothermal energy sources in the Venetie area.

3.2.3 Hydroelectric

Venetie is located adjacent to the Chandalar River, a low gradient braided river which excludes the possibility of hydropower. A 1981 study by the US Army Corps of Engineers found that only the Yukon River and its tributaries have hydropower potential in the area; however, due to the lack of storage sites no viable hydroelectric potential exists in the area[2].

3.2.4 Wind Generation

The AEA-Alaska High Resolution wind map categorizes the wind resource in the immediate vicinity of Venetie as Class 1 - Poor.[3]

The 2013 Sandia report found that the Venetie is in a region that has a mean wind velocity too low to make wind power a practical solution. However, located 10 miles to the northwest of Venetie is a ridge that was rated as fair. Further west along the ridge, 16 miles from Venetie, is an area rated outstanding to superb, but more wind monitoring data is needed. This report concluded that maintenance may also be difficult or impossible due to deep snow fall and the distance from Venetie. The “costs and future maintenance of running transmission lines to areas of high wind energy potential may make this an unrealistic source”.[4]

3.2.5 Solar

The 2013 Sandia report found that solar or “PV” is a viable alternative though not without significant drawbacks. First, due to Venetie’s location near the Arctic Circle there is limited to no sunlight during the winter which happens to coincide with the greatest power demand. Conversely, the late spring/early summer months, when solar has the greatest potential, are the months with low power demand by the village.[5]

The Sandia report identified the most cost-effective PV system would be a 23kW system without any energy storage. However, the smallest diesel electric generator would still need to be operated in order to meet the balance of the community load. This lightly loaded diesel generator would then be operating in an inefficient mode.

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[2] US Army Corps of Engineers. **National Hydroelectric Power Resources Study, Regional Assessment: Alaska and Hawaii**. No City. Us Army Corps of Engineers, September 1981. Volume XXII, 2-3.
[3] Alaska Energy Authority. **High Resolution Wind Map.** *Alaska Energy Authority Website,* April 26, 2018.
[4] Sandia National Laboratories. **Venetie, Alaska Energy Assessment**. Albuquerque, New Mexico. Sandia National Laboratories, July 2013. 30.
[5] Sandia National Laboratories. **Venetie, Alaska Energy Assessment**. Albuquerque, New Mexico. Sandia National Laboratories, July 2013. 14.

3.3 Estimated Fuel Storage Capacity Requirements

Everts Air Cargo is the primary fuel supplier; their air tanker has a carrying capacity of 4,400 gallons. The average utility diesel fuel usage is reportedly 4,000 gallons per month, requiring fuel deliveries every three to four weeks. In practice, deliveries occur more often to accommodate school and residential heating and retail fuel sales demands. Based on a review of available fuel delivery information the overall diesel fuel consumption in the community is approximately 1,300 gallons per week. Given that all fuel deliveries occur via air tanker, Venetie does not require a large bulk fuel storage volume in contrast to communities that receive fuel via barge only 1 or 2 times per year. However, the community has experienced fuel shortages in the past due to extended weather events and mechanical issues with the regional air tanker companies, etc. To address this issue, the Venetie Village Council requested 3 months of diesel fuel storage be provided at the proposed tank farm. At 1,300 gallons per week this equates to an overall diesel storage capacity of 16,000-gallons. Gasoline is delivered on an as-needed basis throughout the year. The Village of Venetie requested a gasoline storage tank at the tank farm with sufficient capacity to receive a full load from the Everts Air tanker plane. Based on this, a minimum 5,000-gallon gross capacity tank is required.

4.0 PROPOSED ENERGY PROJECT DESCRIPTIONS

The proposed Venetie energy infrastructure projects are described in the following three sections:

- Section 4.1, "Diesel Power Plant Replacement" describes the proposed construction of a new power plant including structure, generation equipment, switchgear, controls, and supporting mechanical and electrical systems.
- Section 4.2, "Diesel Generation Heat Recovery", describes the proposed heat recovery project serving the sanitation facility, old washeteria building, and clinic.
- Section 4.3, "Electrical Distribution System Upgrade", describes proposed replacement of the electrical distribution system.
- Section 4.4, "Fuel System Upgrade", describes proposed replacement of the fuel system.

4.1 Diesel Power Plant Replacement

Due to the age and condition of the existing building, the high run-time hours on the existing gensets, and the obsolete switchgear, it is recommended that the existing power plant be replaced with a new power plant. Keeping the existing power plant in operation while the new power plant is completed and commissioned will eliminate the project cost of providing temporary community power during construction. Options for a site-built power plant versus a prefabricated modular power plant were considered. Low water levels on the Chandalar River and the inability of barges to access the village preclude the use of a prefabricated module design.

The new power plant will be located adjacent to the existing power plant and next to the proposed new sanitation facility as shown on the site plan in Appendix A.

This location readily supports connecting the new power plant to the existing electrical distribution and heat recovery systems.

The power plant will be a site-built 18'x40' wood framed structure with metal roofing and siding. The floor system will be prefabricated steel panels field welded together to provide liquid tight containment. The foundation will consist of raised steel beams supported on concrete pads with adjustable shim plate leveling connections.

The power plant will be equipped with separate generation and control rooms. The generation room will contain three generators and associated mechanical equipment. The control room will contain programmable automatic paralleling switchgear and SCADA equipment. The building will have sound insulated construction and the engines will be equipped with critical grade silencers to reduce noise.

The following features are proposed for the new power plant:

- Sound insulated control room and separate generation room
- Three phase 277/480V generation
- Programmable automatic paralleling switchgear with remote SCADA and accommodations for incorporating future alternative energy production.
- New pad-mount step up transformer and community feeder connection to the existing distribution system
- Heat recovery system as described in the following section.
- Water mist fire suppression system.
- New 8,000-gallon double wall intermediate tank located adjacent to the power plant.
- 200-gallon autofill day tank with direct pipeline connection to intermediate tank

The power plant layout is shown on drawing M1 in Appendix A. Additional description of major components follows.

4.1.1 Generator Selection

Proper sizing and selection of the diesel generators is necessary to meet the community electric loads while minimizing fuel consumption. To meet the community electric loads the new diesel power plant will have one 210kW 6090AFM85 Tier 3, one 150kW 6068AFM85 Tier 3, and one 101kW 4045AFM85 Tier 3 marine engines. These engines are reliable, fuel efficient, and are equipped with a marine exhaust manifold which provides nearly twice the jacket water heat compared to an industrial conventional engine for improved recovered heat availability.

4.1.2 Switchgear & SCADA

The new switchgear will have a total of 5 sections - one for each diesel generator; one for master control and metering; and one for the distribution feeder breaker, which will also house the radiator variable frequency drive controllers and the station service breaker. The switchgear will be fully automatic with paralleling

capability and will utilize a programmable logic controller (PLC) to automatically match the running generator(s) to the community load.

The new switchgear will include a SCADA system for remote generation and distribution monitoring. A desktop PC will be provided in the control room to allow operator access and control of the different systems.

The new switchgear will provide automatic paralleling and load control of the three generating units. The load control system will monitor the electrical demand on the generators and automatically select the appropriately sized generating unit required to meet the demand. The switchgear will automatically start the most suitable engine, bring it up to speed, synchronize the unit, and close the engine circuit breaker. When a unit is taken offline, either for maintenance or due to a reduction in electric load, the switchgear will automatically remove the unit from the bus and allow the engine to cool down before shutdown. Generator controls and relaying will provide protection and monitoring of each engine-generator and the feeders.

4.1.3 Power Plant Fuel System

Venetie Power Plant Intermediate Tank Sizing

Peak Monthly Power Generation (January 2020)	105,000kW
Expected Average Fuel Efficiency of New Power Plant	11.5kWhr/Gal
Peak Monthly Fuel Use	9,000 Gal
Tank Size for Approximate Three Week Supply of Fuel	8,000 Gal

In order to provide fuel storage for a minimum of three weeks of power production, an 8,000 gallon double wall intermediate tank will be located adjacent to the module. The tank will be in compliance with EPA requirements for redundant overfill protection for alternative secondary containment systems. It will also be equipped with a fill limiter, clock gauge, gauge hatch, pressure/vacuum whistle vent, and emergency venting. A welded steel day tank supply pipeline will include a flanged 1" actuated ball valve located at the tank connection for automatic isolation of the tank and pipeline between day tank fill cycles. The intermediate tank will be top filled and equipped with a ground-level quick connect and spill catch basin. The tank will be truck filled from the airport tank farm every one to two weeks as required. The EPA requires general surface flow containment around a fuel truck during fuel transfers to a regulated facility in order to prevent fuel spills from entering navigable waters. Surface flow containment requirements for the power plant tank will be met by appropriate grading of the truck staging area.

A new automatic fill 200 gallon fuel oil day tank will be installed inside the power plant. It will be equipped with a gear pump, redundant overfill protection and alarm systems, a hand priming pump, and a totalizing meter. The plant will also be equipped with a used oil blending system. Used engine oil will be pumped into a hopper during oil changes. Each time the day tank fills the system will filter and blend used oil with diesel fuel a ratio of 0.5% of used oil to diesel fuel.

All fuel and oil piping will be schedule 80 steel. All interior fuel and oil piping will have either welded or threaded joints. Each isolated section of piping will be provided with pressure relieving devices to account for thermal expansion of product caused by temperature fluctuations. Provisions for movement of the piping caused by thermal expansion and contraction will be included. All valves will be steel body industrial grade valves intended for use with fuels.

4.1.4 New Power Plant Connection to Distribution System

A new 225kVA 3 phase pad-mount step up transformer will be installed adjacent to the new power plant. Buried primary cable will be routed from the new transformer to the existing primary distribution system.

4.1.5 New Power Plant Connection to Old Power Plant

Power will be provided to the old power plant building after decommissioning. A dedicated 208V 3-phase circuit breaker will be installed in the new power plant panelboard for this purpose. Above grade conduit and conductor will be routed to a fused disconnect mounted on the exterior of the old power plant. Connection of the existing station service panelboard in the old power plant to the new fused disconnect will be by others and is not in this project scope. The entire building will also be without a heat source after decommissioning the old power plant. Due to the construction and condition of the building it is best suited for cold storage.

4.2 Diesel Generation Heat Recovery

An analysis of available diesel generation heat recovery was conducted with four possible end user facilities: 1) the old washeteria building (after decommissioning); 2) the clinic; 3) the proposed new sanitation facility; and 4) the portions of the BIA buildings which are slated for future renovation. The analysis is based on community PCE generation data, proposed Tier 3 marine genset heat rejection data, and estimated annual heating requirements at the proposed end user buildings. The analysis indicates that the new heat recovery system may displace up to 17,000 gallons of heating fuel per year if all end users are connected. This is sufficient to provide for virtually all of the heating requirements for the first three proposed end users but only a portion of the heat for the BIA facility. The complete results are included in Appendix E.

It is possible that the new power plant will be completed prior to the proposed new sanitation facility and / or the BIA building renovations; therefore, a phased approach may be necessary for installation of the new heat recovery system. Multiple system connections will be provided in the power plant to accommodate connecting heat recovery end user buildings as they are completed. Following are the preliminary proposed heat recovery construction phases depending on funding availability and final system design:

Phase 1 – Install new above grade 2” steel arctic pipe from the new power plant to the washeteria concurrently with new power plant construction and connect to the existing washeteria/clinic heat loop.

Phase 2 – Upon completion of the new sanitation facility install new above grade steel arctic pipe from the new power plant and connect to the building heating system. Provide any additional piping, controls or metering required for complete

integration into the new heat recovery system as well as system connections to accommodate the future connection of the BIA facility. After the new sanitation facility heat recovery connection is completed perform any renovations required for incorporating heat recovery into the old (decommissioned) washeteria and to ensure continued heat recovery supply to the clinic.

Phase 3 – Upon completion of the BIA facility renovations install new above grade steel arctic pipe from the sanitation facility and connect to the facility heating equipment. Provide any additional piping, controls or metering required for complete integration into the new heat recovery system.

The proposed diesel heat recovery project consists of the following components when fully complete:

- Heat exchanger, pumps, expansion tank, and associated equipment in the power plant.
- Recovered heat BTU totalizing meter in the power plant.
- Alarms for loss of flow, loss of pressure, and no load/backfeed condition with annunciation in the power plant switchgear.
- Approximately 400 feet of new above grade steel arctic pipe from the new power plant to the washeteria with devices and fittings as required for connection to the existing washeteria and clinic heat recovery systems.
- Existing buried arctic pipe to the clinic as well as heat exchangers, pumps and controls at the washeteria and clinic to remain in service as part of the new heat recovery system.
- Approximately 200 feet of new above grade steel arctic pipe from the new power plant to the new sanitation facility with devices and fittings as required for connection to the heat recovery system.
- Approximately 200 feet of new above grade steel arctic pipe from the sanitation facility to the BIA facility with devices and fittings as required for connection to the heat recovery system.
- Possible metering for recording energy delivered to the new sanitation facility and/or the BIA facility.

The site plan in in Appendix A shows the proposed heat recovery pipeline routing.

4.3 Community Electric Distribution System Upgrade

Based on the age of the existing system, and deficiencies observed during the October 2020 site visit, the proposed upgrades will likely include replacement of all power poles, transformers, primary/secondary voltage lines, etc. in the community. Sections of the existing system in good condition, such as the airport circuit and newer poles serving the school complex, will be retained and reused where feasible. It is anticipated that the improvements will be constructed in phases to minimize outages. Where possible, the existing distribution system will remain in service during construction of the new system. Once the new system is energized and all service cutovers are complete, the existing primary will be decommissioned and removed. The existing community step up transformer bank

will be replaced with a single 225kVA 3 phase pad mount transformer adjacent to the new power plant. A new buried feeder from the power plant and a riser pole will be used to serve the new system. Other upgrades will include new service drops, and rebalancing of the system to more equally distribute load amongst the three phases. Properly balancing the system may require that a portion of the existing single phase airport circuit be upgraded to 3-phase.

Design Standards:

The following standards will be used in the design and construction of the new underground distribution system.

- RUS Bulletin 1728F-804: Specifications and Drawings for Overhead Electrical Distribution.
- 2007 National Electrical Safety Code.

4.4 Fuel System Upgrade

Proposed bulk fuel upgrades consist of three facilities: 1) a new tank farm owned by the Village of Venetie and located at the airport; 2) a new village-owned retail dispensing facility located near the village store; and 3) new storage tanks located near the school.

The proposed airport tank farm will be owned and operated by the Village of Venetie and will consist of two 8,000-gallon double wall ASTs (diesel storage) and one 5,000-gallon double wall AST (gasoline storage). The tanks will be configured for transport via C-130 aircraft. The tanks will be filled via a new dual product airplane header and 3” diameter welded steel fill pipelines. A truck fill secondary containment area and truck fill header will be installed adjacent to the new tank farm. Submersible pumps in each bulk tank and welded steel fill pipelines will facilitate filling of local fuel tanker trucks, which will then transport the fuel to intermediate and end use tanks within the community. Intermediate tanks at the power plant, clinic, etc. will be filled via the community fuel truck using approved fill ports with camlock couplings and drip pans. During final design, consideration will also be given to the use of single wall horizontal ASTs within a lined earthen containment dike. The final decision regarding containment will be based on comparative cost analysis and community preference.

The proposed retail dispensing facility will consist of a new 3,000-gallon, dual product, protected dispensing tank with an integral two-product retail dispenser. The facility will be located adjacent to the village office for retail sale of diesel and gasoline. The sales system will be simple, utilizing hand written receipts (no credit card reader, etc.).

The AEA is still in preliminary discussions with the regional school district (Yukon Flats School District) regarding potential project participation. Based on discussions to date, the District is interested in installing two 8,000-gallon double wall ASTs for diesel storage north of the existing school building. The new tanks would be filled via the school’s existing tanker truck (no infrastructure would be required at the airport). Further, the facility would be connected to existing steel piping feeding an existing interior day tank in the school mechanical room. A final

decision on the level of School District participation will be needed prior to beginning final design.

Existing tanks owed by project participants will be drained, cleaned, and rendered unusable by the project. Final disposal of the tanks will be the responsibility of the tank owner(s).

5.0 SITE SELECTION & CONTROL

Work for this project will be performed in three general areas as described in the following sections: (5.1) “Power Plant Site”; (5.2) “Heat Recovery System Areas”; (5.3) “Electrical Distribution System Upgrade Areas”; and (5.4) “Bulk Fuel Upgrade Areas”. A detailed topographic survey will be performed early in the design phase to establish elevation benchmarks, provide detailed surface contour elevation data and locate above grade improvements and below grade utilities for final design.

When the Alaska Native Claims Settlement Act (ANCSA) was passed in 1971, Venetie opted for title to the 1.8 million acres of land in the former reservation. As such, the Native Village of Venetie is the owner of all surface and subsurface estates in the community and surrounding area per patent 50-80-0027 recorded at book 25, page 279, Fairbanks Recording District. With the exception of the school lease lot and several public utility easements in town, there are no private inholdings, subdivision plats, rights of way, or other site control related elements in the community. All proposed project facilities are located on lands owned by the Native Village of Venetie.

The potential natural hazards due to Venetie’s geographical location include earthquake and river bank erosion. According to the U.S. Army Corps of Engineers, Flood Plain Management, Alaskan Communities Flood Hazard Data, October 2011, there is no known flooding at the proposed power plant and tank farm sites.

5.1 Power Plant Site

The proposed new power plant site was approved by the Village Council via a verbal vote on October 7, 2020. The site is located approximately 50’ north of the existing power plant.

Golder Associates prepared a geotechnical report for the project that summarizes available geotechnical data in and around the project area and provides foundation recommendations. The most relevant test pits were advanced on July 29, 2019 by ANTHC for the Central Sanitation Facility project. Four test pits were advanced in and around the proposed power plant footprint. The test pits were excavated with a local rubber tire backhoe to about 10 feet below grade. Similar subsurface conditions were encountered in all test pits. Unclassified granular fill overlying sequences of in-place mineral silt and silt with sand to depth. The water table was encountered around 10’ below grade.

Based on available information, the site is considered suitable for the proposed development using shallow concrete footings. Detailed foundation

recommendations are provided in the Golder report and are summarized below: Prepare the power plant site by removing existing gravel topping and any deleterious material to expose in-situ mineral soils. Excavate a minimum of 3-ft into mineral soils beneath power plant concrete footings, proof compact the in-situ mineral soils and install approved geotextile fabric before backfilling with approved classified fill material. Place fill in maximum 8-inch lifts and compact to 95% of maximum. Install a minimum of 4-inches rigid board insulation beneath the power plant footings in accordance with the geotechnical report recommendations.

As currently envisioned the power plant foundation will consist of four to six shallow concrete footings cast directly within the classified structural fill. The power plant will include a steel floor and steel-skid foundation that will be attached directly to the concrete footings using an adjustable foundation system.

5.2 Heat Recovery System Areas

The proposed Heat Recovery pipeline mains are routed entirely within a public utility easement (2007-010736-0) granted by the Venetie Village Council on 5/22/2007. Work will also be performed inside Village-owned buildings (washeteria and clinic buildings).

5.3 Electrical Distribution System Upgrade Areas

Electrical distribution system upgrades will occur entirely on property owned by the Village of Venetie. A portion of the improvements may also be located within the school lease parcel (lease to State of Alaska, Bk 417, pgs. 270-300, Fairbanks Recording District). Additional site control and easement acquisition are not anticipated but, if necessary, would occur during final design depending on final alignment of the distribution system.

5.4 Bulk Fuel Upgrade Areas

The proposed new airport tank farm site is located adjacent to the existing airport tarmac, on lands owned by the Village of Venetie. According to Vickie Swain (Chief, ADOT&PF Central Region Aviation Leasing), the Venetie airport is owned by the Venetie Tribal government and the State of Alaska has no ownership or interest in the facility. Based on this, the primary driving forces for site selection are the preferences of the land owner (Village of Venetie), code related setbacks (there are no official property boundaries and only one building at the airport so setback requirements are minimal), and FAA regulations. Based on a review of the existing Airport Layout Plan, and discussions with Patrick Zettler (FAA Alaska District Lead Civil Engineer), the proposed tank farm can be located outside of the established “Building Restriction Line” as depicted in the concept drawings in the appendices. However, the final location of the tank farm will be subject to formal FAA review (Form 7460). Geotechnical recommendations by Golder Associates are similar to the recommendations for the power plant site (e.g. remove surface fill / organics to mineral soils, proof compact, and install a nominal 3-ft structural fill pad). Use of rigid board insulation is optional but may be beneficial to minimize seasonal frost related ground movement.

The proposed new School District tank site is located north of the existing school building, within the School Lease Parcel. No geotechnical investigation has been performed at this site. However, given the nature of the proposed improvements (a couple relatively small double wall ASTs on a gravel pad) we anticipate that the

ground conditions at the site are suitable for construction with minimal improvements.

The proposed new retail dispensing facility (5,000-gallon skid mounted, protected tank with integral dispenser) will be located adjacent to the existing Village Store (near the existing retail dispensing tanks). This site is owned by the Village of Venetie. Siting of the tank will be controlled by code required setbacks and owner preference.

6.0 PERMITTING

The proposed projects are subject to regulations of State and Federal agencies including the Alaska Department of Environmental Conservation (ADEC), the Division of Fire Prevention, Department of Fish and Game, Federal Aviation Administration, U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, and the Corps of Engineers.

6.1 Environmental Review

Project level environmental review, in accordance with Denali Commission National Environmental Policy Act (NEPA) implementing procedures and consistent with 45 CFR 900, will be completed prior to construction of the proposed projects. A Project level environmental review is required for all projects that are federally funded or require a federal permit. The environmental review determines whether there is a significant impact to the environment caused by the project. The Alaska State Historic Preservation Officer (SHPO) will be consulted. Based on preliminary review of the state of Alaska historical archive records, the SHPO is expected to concur with a finding of No Historic Properties Affected for the project. The Project should qualify as a Categorically Excluded (CATEX) project under 45 CFR 900, Appendix B, and a Denali Commission CATEX Checklist will be completed for the project.

6.2 Fire Code

A Plan Review permit from the State Fire Marshal is required for the proposed power plant and fuel related improvements. Final stamped design drawings will be submitted to the Fire Marshal for review prior to construction. Plans will be reviewed for conformance with the International Fire Code and related codes including the International Building Code and the National Electrical Code. The review process typically takes 3 to 6 weeks.

6.3 Spill Response

The community does not currently maintain a SPCC plan. As part of this project a SPCC plan will be developed to comply with U.S. Environmental Protection Agency, Spill Prevention Control and Countermeasures (SPCC) plan requirements.

6.4 Air Quality Permit

The ADEC requires diesel-electric power generation facilities to comply with 18AAC50 air quality control requirements. An air quality permit is required for facilities that have the potential to emit in excess of 100 tons/year of NOx. ADEC regulations, 18 AAC 50.230 (c), stipulate that a facility has the potential to emit 100-tons of NOx per year if the total installed diesel engine capacity exceeds 736 horsepower. The new Venetie power plant will have a total diesel engine capacity less than 736 horsepower and therefore will not require a permit.

6.5 Electrical Distribution System Permitting

It is expected the electrical distribution project will be constructed in phases, as construction funding is available. Each phase of the project will be reviewed to ensure all required permits have been secured prior to construction. Should any of the phases cross wetlands, it is expected they will be permitted under the Corps of Engineers, Nationwide Permit No. 12. NWP 12 authorizes utility line activities that do not result in the loss of greater than ½-acre of waters of the United States. Further consultation with the agencies will be conducted during Phase 2, Final Design and Permitting, to ensure the project secures all necessary permits and complies with state and federal requirements.

7.0 CONSTRUCTION PLAN

7.1 Administration

It is assumed that this project will be constructed using conventional contracting methods. The design engineer will prepare construction drawings, specifications and bid documents. The project will be advertised in accordance with applicable procurement policies and sealed bids will be accepted from qualified Contractors. At the appointed date and time the sealed bids will be opened and evaluated.

Once a contract is in place, the Contractor will coordinate procurement and construction activities. The design engineer will provide quality assurance and control services through communication with the Owner and Contractor, review of submittals and shop drawings, and intermittent site inspections.

7.2 Use of Local Labor and Equipment

Local labor and equipment resources are limited in the community. A list of available local labor and heavy equipment may be obtained from Clayton Tackett (Council Member and Assistant to the Tribal Administrator) at 907-849-8212.

7.3 Gravel Source

Gravel will be required for pad development, finish grading and concrete for the new power plant. There are several established local borrow pits. The primary borrow pit is located approximately 2-miles west of the proposed power plant site along the slough road, on land owned by the Village of Venetie. This borrow pit has been used for multiple road and construction projects in recent years. The pit run material consists of a silty gravel that is generally suitable for pad construction. A sample is currently under analysis for potential use as concrete aggregate. Should aggregate for concrete be unavailable from the borrow site, it will need to be imported for the project.

7.4 Access and Logistical Challenges

Access to Venetie is almost exclusively by air. The Venetie Tribal Council owns and operates the 75’ x 4,000’ gravel airstrip, which is located approximately 1 mile east of town. The Chandalar River provides limited access by boat from May to October. Barges do not reach the community due to shallow water.

8.0 SCHEDULE

We understand that funding for final design and construction is pending additional input from AEA and the Denali Commission. The schedule below assumes that

funding for final design will be released by February 2021 and construction funding will be available for power plant, heat recovery, and bulk fuel improvements by June 2021. A schedule for the proposed electrical distribution improvements is not provided in the CDR as we understand these improvements will be accomplished in phases subject to future funding availability.

Proposed project schedule:

- December 2020 / January 2021: Finalize CDR
- February 1 2021: Receive design NTP for power plant, heat recovery, and bulk fuel scope items.
- June 1, 2021: Submit final design / bid documents
- June 2 – July 14: Advertise, receive bids, protest period, award contract. Recommended contract completion date October 2022
- Summer / Fall 2021: Contractor mob, Power Plant and Tank Farm site work / foundation preparation. Coordinate with ongoing ANTHC Sanitation Facility project.
- Fall 2021: Complete submittal review
- Winter 2021 / 2022: Winter shutdown on site. Contractor to complete project material procurement / buy out.
- Spring 2022: Contractor Remobilization
- Summer 2022: complete power plant, recovered heat and tank farm work.
- Fall 2022: Power Plant Testing, Start Up, and System Commissioning
- Winter 2022: Record Drawings, O&M Manuals, Project Closeout

A more detailed construction scheduled will be developed during final design and permitting.

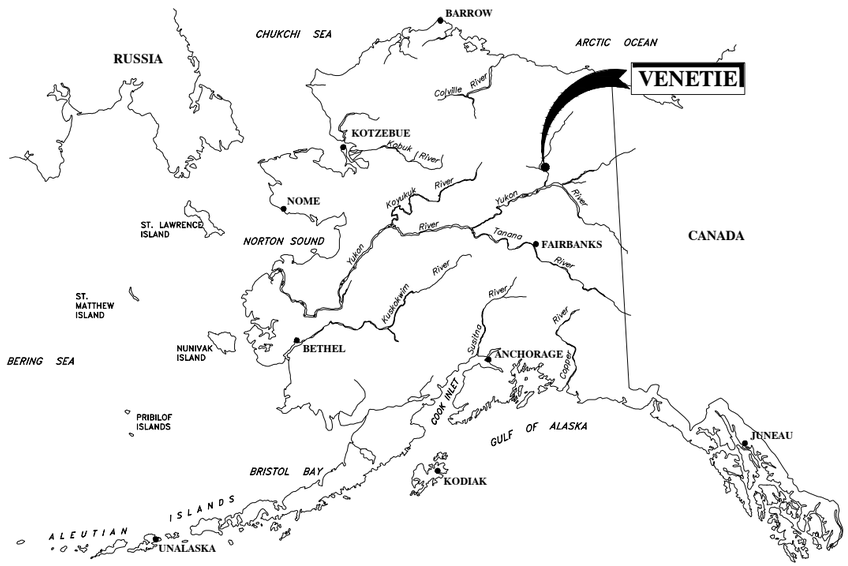
9.0 COST ESTIMATE

It is assumed that the proposed improvements will be constructed using conventional design-bid-build contracting techniques. A summary of the estimated total construction costs is provided below, including all contractor provided labor, materials, equipment, freight, contractor overhead and profit, and a 15% contingency: Detailed cost estimates are included in Appendix B. Separate estimates are provided for each line item listed below.

$2,500,091	**Power Plant Upgrade (Including Ph 1 Heat Recovery)**
$ 94,500	**Heat Recovery Phase 2 (Central Sanitation Building)**
$ 146,063	**Heat Recovery Phase 3 (BIA Facility)**
$1,495,025	**Village of Venetie Bulk Fuel Tank Farm))**
$ 483,338	**Yukon Flats School District Bulk Fuel Tank Farm)**
$1,492,678	**Power Distribution Upgrades**
$6,211,696	**TOTAL COST ALL PROPOSED ENERGY PROJECTS**

Appendix A

Concept Design Drawings

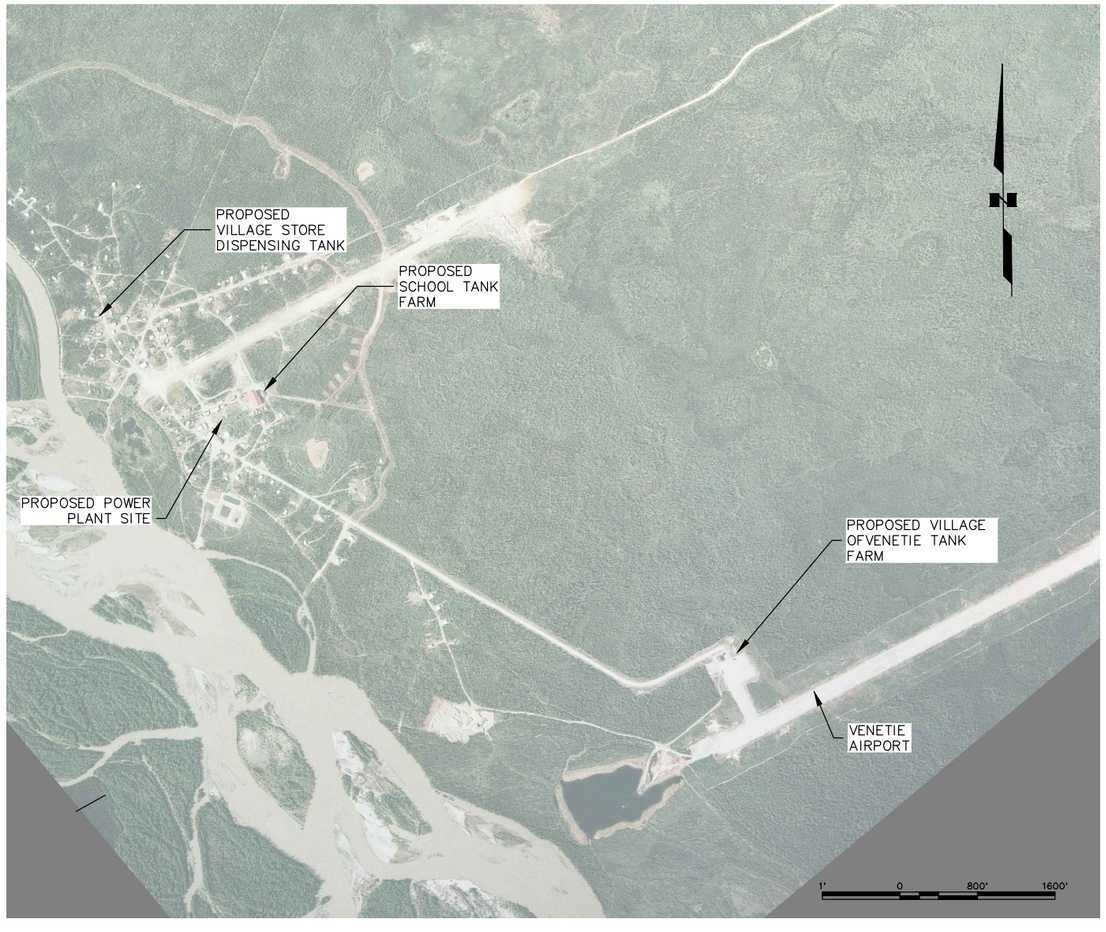


ALASKA ENERGY AUTHORITY

813 West Northern Lights Blvd.
Anchorage, Alaska 99503

VENETIE, ALASKA

ENERGY INFASTRUCTURE UPGRADE PROJECT CONCEPT DRAWINGS DEC 2020



SHEET INDEX

Project Number (Consultant) 30416.00 (AEA) _____
AEA Project Manager WILLIAM PRICE, PE
Construction Manager _____
Final Design (Date) _____
Fire Marshal Approval (Date) _____
Construction Period (From) _____ (To) _____
As-Builts (Date) _____

CRW ENGINEERING GROUP, LLC
3940 Arctic Blvd. Suite 300
Anchorage, Alaska 99503
PHONE: (907) 562-3252
#AKCL882-AK

Gray Stassel Engineering, Inc.
P.O. 111405, Anchorage, AK 99511 (907)349-0100

PROJECT SCOPE

THIS PROJECT INCLUDES THE FOLLOWING SCOPE:

- CONSTRUCT NEW GRAVEL PAD FOUNDATIONS FOR A NEW POWER PLANT AND TWO NEW TANK FARMS LOCATED AT THE AIRPORT AND SCHOOL.
- THE NEW AIRPORT TANK FARM INCLUDES TWO NEW 8,000 GALLON DIESEL ASTs AND ONE 5000 GALLON GASOLINE AST. THE NEW SCHOOL TANK FARM INCLUDES TWO NEW 8,000 GALLON DIESEL ASTs.
- CONSTRUCT NEW POWER PLANT.
- INSTALL NEW 8,000 GALLON INTERMEDIATE TANK AT NEW POWER PLANT.
- INSTALL NEW 5000 GALLON DISPENSING TANK AND TWO PRODUCT RETAIL DISPENSER AT THE VILLAGE STORE.
- CONSTRUCT HEAT RECOVERY SYSTEM UPGRADE.
- UPGRADE EXISTING ELECTRICAL DISTRIBUTION SYSTEM.

GENERAL NOTES

1. THE CONTRACTOR SHALL PROTECT ALL ITEMS NOT SCHEDULED FOR DEMOLITION DURING CONSTRUCTION. DISTURBED AREAS SHALL BE RESTORED TO PRE-CONSTRUCTION CONDITION.
2. ALL EXISTING UTILITIES MAY NOT BE SHOWN ON THESE PLANS. THE CONTRACTOR SHALL CONSULT WITH THE APPROPRIATE UTILITY ORGANIZATIONS TO VERIFY AND LOCATE UTILITIES PRIOR TO CONSTRUCTION. SEE "CALL BEFORE YOU DIG" CONTACT INFORMATION ON THIS SHEET.
3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE APPROPRIATE TEMPORARY CUT SLOPES AND SHORING FOR EXCAVATIONS AND TRENCHES FOR SITE SOILS, GROUNDWATER AND RUNOFF CONDITIONS AND SURFACE LOADING CONDITIONS. THE CONTRACTOR MUST COMPLY WITH APPLICABLE FEDERAL AND STATE OSHA REGULATIONS. THE CONTRACTOR SHALL MAINTAIN ALL SIGNS, BARRICADES, WARNING LIGHTS AND OTHER PROTECTIVE DEVICES NECESSARY FOR SAFETY AND TRAFFIC CONTROL.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING THEIR WORK WITH EXISTING FACILITY OPERATORS, OTHER CONTRACTORS, SUBCONTRACTORS, THE CITY AND STATE AND FEDERAL AUTHORITIES.
5. THE DRAWINGS ARE DIAGRAMMATIC AND DO NOT NECESSARILY SHOW ALL FEATURES OF THE REQUIRED WORK. PROVIDE ALL LABOR, EQUIPMENT AND MATERIALS REQUIRED FOR A COMPLETE, AND CODE COMPLIANT SYSTEM. VERIFY EXISTING FIELD CONDITIONS PRIOR TO STARTING CONSTRUCTION. IMMEDIATELY CONTACT THE ENGINEER FOR CLARIFICATION OF QUESTIONABLE ITEMS OR APPARENT CONFLICTS.
6. ALL FEATURES OF THE WORK ARE NEW AND TO BE FURNISHED AND INSTALLED BY THE CONTRACTOR UNLESS SPECIFICALLY INDICATED AS EXISTING. INSTALL ALL MATERIALS AND EQUIPMENT IAW MANUFACTURER'S RECOMMENDATIONS, INSTRUCTIONS, AND INSTALLATION DRAWINGS, UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
7. THE SPECIFICATION OF A NAME BRAND PRODUCT FOLLOWED BY THE "OR EQUAL" PHRASE IS DONE MERELY TO ESTABLISH THE MINIMUM LEVEL OF QUALITY OF MATERIALS AND EQUIPMENT REQUIRED AND IS NOT A PRODUCT ENDORSEMENT. SUBMIT ANY PROPOSED SUBSTITUTIONS FOR REVIEW AND APPROVAL, UNLESS "NO SUBSTITUTIONS" IS SPECIFIED.
8. FACILITY DESIGN IS IAW THE 2012 INTERNATIONAL FIRE CODE, STATE OF ALASKA FIRE AND SAFETY REGULATIONS ADMINISTRATIVE CODES 13 AAC 50, 13 AAC 55, AND THE MEMORANDUM OF AGREEMENT BETWEEN THE AEA AND THE STATE OF ALASKA FIRE MARSHALL AT THE TIME OF DESIGN.
9. CONTRACTOR TO PROVIDE SIGNAGE IAW THE SIGN SCHEDULE, AND AS IDENTIFIED ELSEWHERE IN THE DRAWINGS.
10. PERFORM WORK WITH SKILLED CRAFTSMEN SPECIALIZED IN SAID WORK. INSTALL ALL MATERIALS IN A NEAT, ORDERLY, AND SECURE FASHION, AS REQUIRED BY THE DRAWINGS AND SPECIFICATIONS AND STANDARDS OF GOOD WORKMANSHIP.
11. WHERE PIPE SUPPORTS ARE NOT SHOWN THEY SHALL BE SPACED A MAXIMUM OF 10 FEET ON CENTER IAW THE 2012 UPC.
12. SCHEDULE AND COORDINATE CONSTRUCTION ACTIVITIES SUCH THAT COMPLETE AND OPERABLE POWER GENERATION ARE MAINTAINED AT ALL TIMES.
13. CONTRACTOR SHALL MAINTAIN A "RECORD" SET OF DRAWINGS TO REFLECT FIELD CHANGES THROUGHOUT CONSTRUCTION. RECORD CONSTRUCTION DRAWINGS SHALL BE SUBMITTED TO ENGINEER AT COMPLETION OF THE PROJECT.
14. ALL WORK SHALL BE PERFORMED IAW ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION, AND STATE AND FEDERAL OCCUPATIONAL HEALTH AND SAFETY REGULATIONS.
15. IF ANY ARCHAEOLOGICAL, CULTURAL OR PALEONTOLOGY RESOURCES ARE DISCOVERED AS A RESULT OF CONSTRUCTION ACTIVITIES, CONTRACTORS SHALL STOP ALL WORK THAT WOULD DISTURB SUCH RESOURCES AND CONTACT THE ENGINEER

ABBREVIATIONS

ADEC	ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ADOT	ALASKA DEPARTMENT OF TRANSPORTATION
ALCA	ALUMINUM SURVEY CAP
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
API	AMERICAN PETROLEUM INSTITUTE
APPROX	APPROXIMATE
ASTM	AMERICAN SOCIETY FOR TESTING OF MATERIALS
AST	ABOVEGROUND STORAGE TANK
AWS	AMERICAN WELDING SOCIETY
AVEC	ALASKA VILLAGE ELECTRIC COOPERATIVE
BEG	BELOW EXISTING GRADE
BFG	BELOW FINISHED GRADE
BLDG	BUILDING
CITY	CITY OF VENETIE
CMP	CORRUGATED METAL PIPE
CPEP	CORRUGATED POLYETHYLENE PIPE
CVC	CORNER VERTICAL CONNECTION
DCCED	DEPARTMENT OF COMMERCE, COMMUNITY & ECONOMIC DEVELOPMENT
DEMO	DEMOLISH
DFT	DRY FILM THICKNESS
DIA	DIAMETER
DWG	DRAWING
E	EAST
EA	EACH
EL	ELEVATION
ELEC	ELECTRIC
EPA	U.S. ENVIRONMENTAL PROTECTION AGENCY
ENGINEER	CRW ENGINEERING GROUP, LLC
E-VENT	EMERGENCY VENT
°F	FAHRENHEIT
FBE	FUSION BONDED EPOXY
FF	FINISH FLOOR ELEV.
FG	FINISH GRADE
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
FPT	FEMALE NATIONAL PIPE TAPERED THREAD
FT	FOOT OR FEET
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GPM	GALLONS PER MINUTE
HDG	HOT DIP GALVANIZED
HDPE	HIGH DENSITY POLYETHYLENE
HP	HORSE POWER
HR	HOUR
IAW	IN ACCORDANCE WITH
IBC	INTERNATIONAL BUILDING CODE
ID	INSIDE DIAMETER
IFC	INTERNATIONAL FIRE CODE
IPC	INTERNATIONAL PLUMBING CODE
LF	LINEAR FEET
LB	POUND
LP	LIGHT POLE
M	METERS
MAX	MAXIMUM
ME	MATCH EXISTING
MIL	0.001 INCH
MIN	MINIMUM
MPT	MALE NATIONAL PIPE TAPERED THREAD
N	NORTH
NC	NORMALLY CLOSED
NFS	NON FROST SUSCEPTIBLE (SOIL)
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NPT	NATIONAL PIPE TAPERED THREAD
NTS	NOT TO SCALE
OAE	OR APPROVED EQUAL
OD	OUTSIDE DIAMETER
OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
OZ	OUNCE
PC	POINT OF CURVATURE
PCC	PORTLAND CEMENT CONCRETE
PI	POINT OF INFLECTION
PL	PLATE
PRV	PRESSURE RELIEF VALVE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENT
R	RADIUS
RF	RAISED FACE
S	SEWER
SCH	SCHEDULE
SHPO	STATE HISTORIC PRESERVATION OFFICER
SIM	SIMILAR
SPEC	SPECIFICATION
SQ	SQUARE
SS	STAINLESS STEEL
SSPC	STEEL STRUCTURES PAINTING COUNCIL
SY	SQUARE YARD
TBM	TEMPORARY BENCH MARK
TP	TEST PIT
TS	TUBE STEEL
TYP	TYPICAL
UG	UNDER GROUND
UL	UNDERWRITERS LABORATORY
ULSD	ULTRA-LOW SULFUR DIESEL
UPC	UNIFORM PLUMBING CODE
UST	UNDERGROUND STORAGE TANK
W/	WITH
W	WATER
VC	VERTICAL CONNECTION

TESTING, STARTUP AND COMMISSIONING PROCEDURES

1. CONTRACTOR SHALL PERFORM SYSTEM TESTING, STARTUP AND COMMISSIONING IAW THE PROCEDURES IN THE CONTRACT DOCUMENTS AND IAW MANUFACTURER INSTRUCTIONS. LEAVE ALL WORK SITES IN AN ORDERLY CONDITION CONSISTENT WITH THAT FOUND UPON ARRIVAL.
2. SEE SPECIFICATIONS FOR DETAILED PROCEDURES.

CIVIL LEGEND (GENERAL)

NOTE: SOME DETAILS UTILIZE SYMBOLS NOT IN THIS GENERAL LEGEND. WHERE THIS OCCURS, SYMBOLS ARE DEFINED ON THE SHEET ON WHICH THEY ARE USED.

- GENERAL PROPERTY BOUNDARY
- CENTERLINE
- CULVERT
- EDGE OF GRAVEL
- VEGETATION / TREELINE
- TRAVELED WAY
- FILL SLOPE
- CUT SLOPE
- FENCE
- FIRE EXTINGUISHER
- 20 — GROUND ELEVATION CONTOURS
- BOLLARD
- PP — POWER POLE
- 9 — INFORMATION / WARNING SIGN
- 5 — SHEET NOTE
- SURVEY MONUMENT
- TEST PIT
- XXX — FINISH GRADE ELEVATION
- ø — DIAMETER
- MANHOLE
- PERFORATED DRAINAGE BASIN
- STORM DRAIN CATCH BASIN
- ANTI-SIPHON VALVE
- BALL VALVE
- MOTOR ACTUATED BALL VALVE
- CHECK VALVE
- GATE VALVE
- PRESSURE RELIEF VALVE
- P — PRESSURE TEST TAP
- M — METER
- F — FILTER
- FLEXIBLE CONNECTOR
- WYE STRAINER (MESH SIZE)
- QUICK COUPLING
- SUBMERSIBLE PUMP
- CENTRIFUGAL PUMP
- VERTICAL PIPE TRANSITION
- REDUCER
- LEVEL FLOAT SWITCH
- FS — FLOW SWITCH
- MAGNESIUM ANODE
- STORM DRAIN MANHOLE

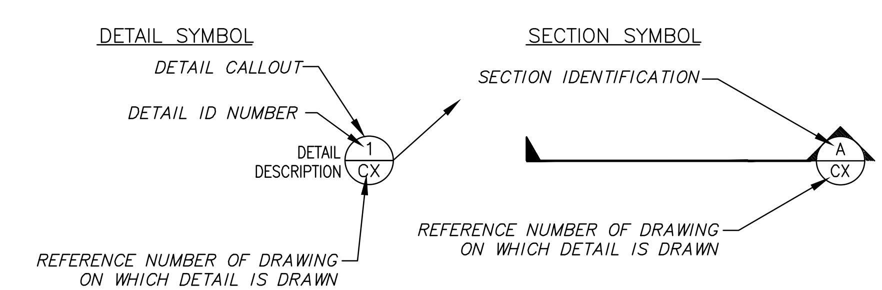
UTILITY LINE/PIPELINE DESIGNATIONS

E	UNDERGROUND ELECTRIC
F	FUEL
FM	SEWER FORCE MAIN
HR	HEAT RETURN
HS	HEAT SUPPLY
S	SANITARY SEWER
SD	STORM DRAIN
W	WATER
WS	WATER SERVICE

- — X — — X — UNDERGROUND UTILITY LINE/PIPELINE: EXISTING
- — X — — X — UNDERGROUND UTILITY LINE/PIPELINE: NEW
- — X — ABOVEGROUND UTILITY LINE/PIPELINE: EXISTING
- — X — ABOVEGROUND UTILITY LINE/PIPELINE: NEW
- GRAVEL EDGE
- VEGETATION / TREE LINE

CALL BEFORE YOU DIG	
WATER/SEWER	
ELECTRIC	

DETAIL/SECTION REFERENCES



CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL862-AK

STATE OF ALASKA 49 TH — Karl R. Hulse CE-10583 — REGISTERED PROFESSIONAL ENGINEER

PROJECT NO. 30416.00 | CITY GRID – | WATER GRID – | SEWER GRID –

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
NOTES LEGEND AND ABBREVIATIONS

DATE: DEC 2020
STATUS: 35% DESIGN DRAWINGS
PROJECT NO: –

REV	DATE	DESCRIPTION	BY
REVISION			

SCALE HOR: – VER: – | DESIGNED BY – | DRAWN BY – | CHECKED BY – | APPROVED BY –

SHEET NO.
G1.1

File: J:\JobsData\30416.00 Venetie Bfu Rpsu Project\001 Cadd 2019\01 Working Set\00 General\30416.00 NOTES LEGEND AND ABBREVIATIONS.dwg   PLOT DATE: 12/10/2020 3:06 PM

1 **VICINITY MAP**

400' 0 400' 800'

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 677-3520
#AECL883-24

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

VICINITY MAP

PROJECT NO: –

STATUS: 35% DESIGN DRAWINGS

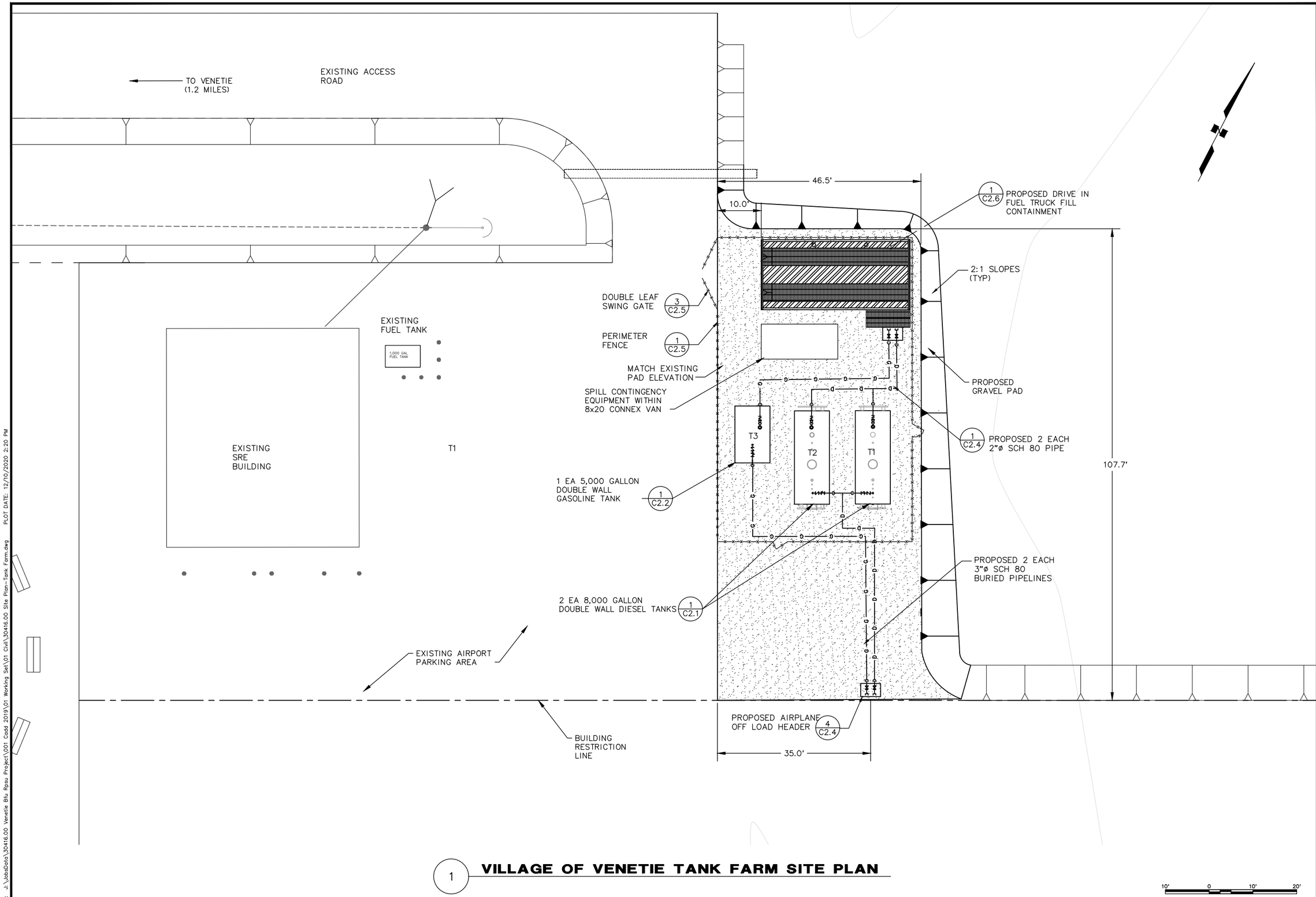
DATE: DEC 2020

REV	DATE	DESCRIPTION	BY
		REVISION	

SCALE
HOR. –
VER. –

DESIGNED BY –
DRAWN BY –
CHECKED BY –
APPROVED BY –

SHEET NO.
C1.1



1 **VILLAGE OF VENETIE TANK FARM SITE PLAN**

10' 0 10' 20'

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 677-3520
#AECL883-24

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
TANK FARM SITE PLAN

DATE: DEC 2020
STATUS: 35% DESIGN DRAWINGS
PROJECT NO: –

REV	DATE	DESCRIPTION	BY

SCALE HOR. – – VER.
DESIGNED BY –
DRAWN BY –
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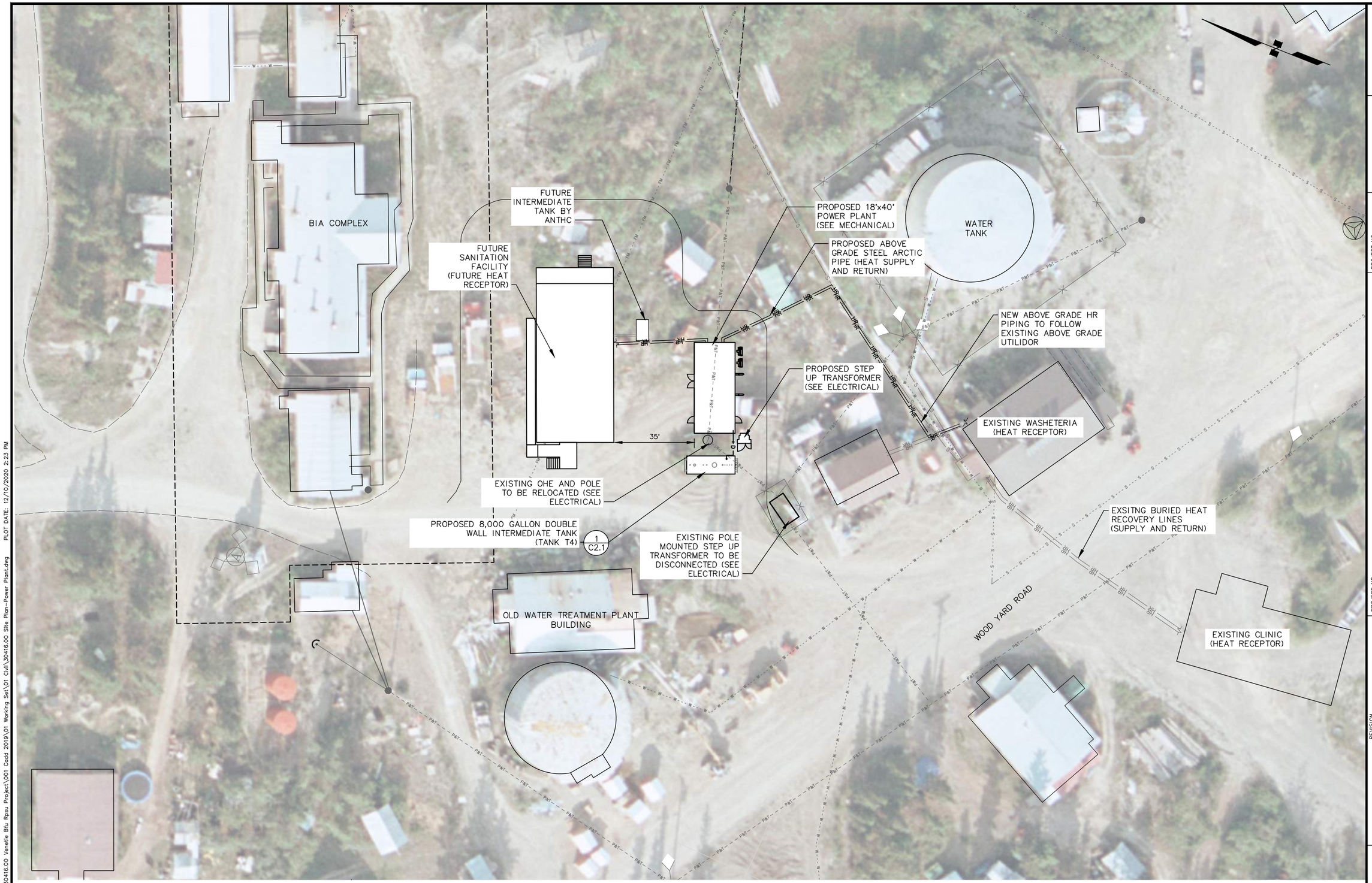
APPROVED BY –

SHEET NO.
C1.2

File: J:\Jobsdata\30416.00 Venetie Btu Rpsu Project\001 Cadd 2019\01 Working Set\01 Civil\30416.00 Site Plan-Tank Farm.dwg PLOT DATE: 12/10/2020 2:20 PM



1 **POWER PLANT SITE PLAN**

20' 0 20' 40'

CRW ENGINEERING GROUP LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE (907) 677-3520
#AECL883-24

PROJECT NO. 30416.00 | CITY GRID - | WATER GRID - | SEWER GRID -

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

POWER PLANT SITE PLAN

PROJECT NO: -

DATE: DEC 2020

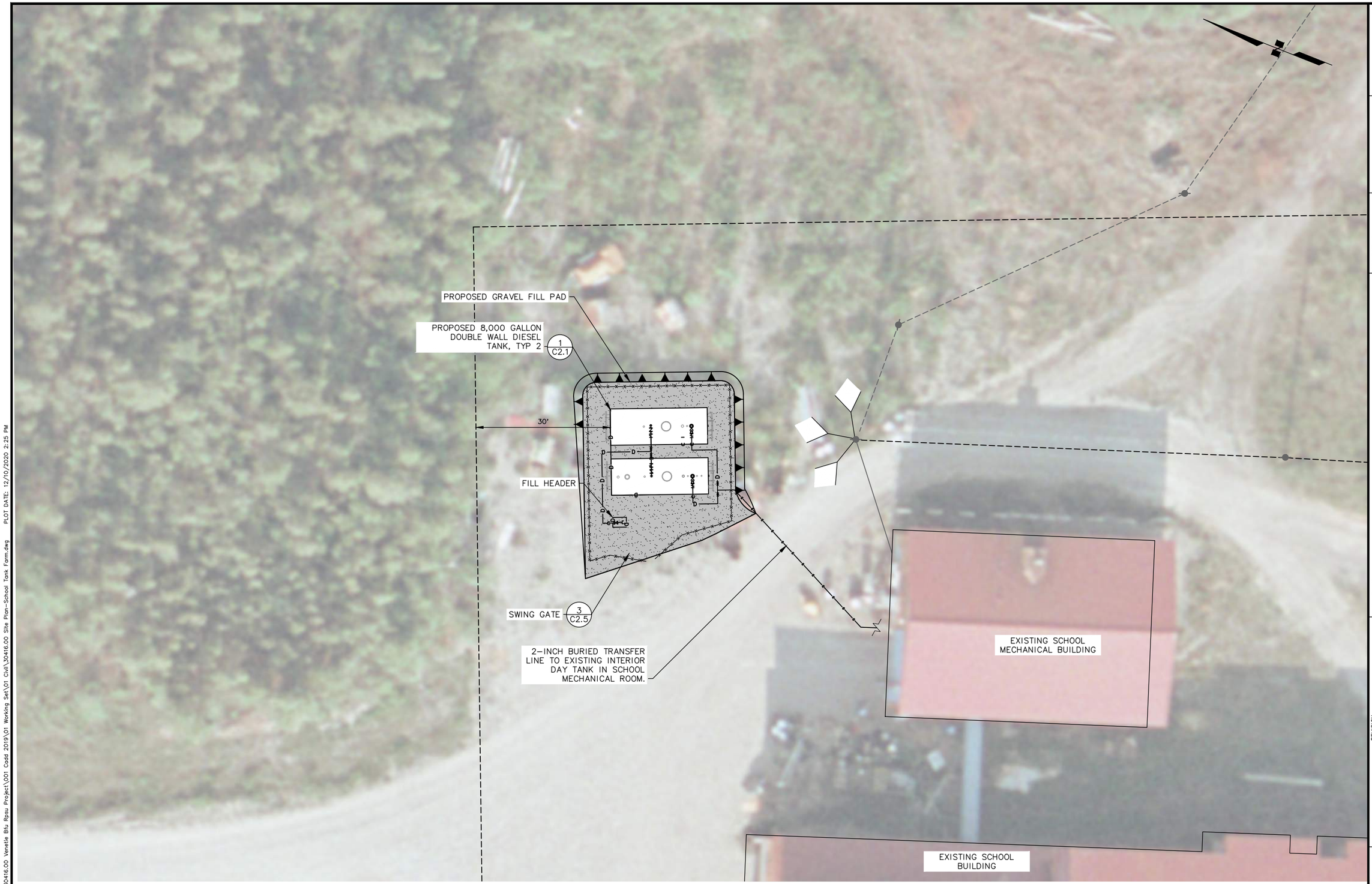
STATUS: 35% DESIGN DRAWINGS

REV	DATE	DESCRIPTION	BY
REVISION			

SCALE HOR. - | VER. -
DESIGNED BY -
DRAWN BY -
CHECKED BY -
APPROVED BY -

SHEET NO.
C1.3

File: J:\JobsData\30416.00 Venetie Bfu Rpsu Project\001 Cadd 2019\01 Working Set\01 Civil\30416.00 Site Plan-Power Plant.dwg PLOT DATE: 12/10/2020 2:23 PM



1 **SCHOOL TANK FARM SITE PLAN**

10' 0 10' 20'

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 677-3652
#AECL883-24

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
SCHOOL TANK FARM SITE PLAN

PROJECT NO: –
STATUS: 35% DESIGN DRAWINGS
DATE: DEC 2020

REV	DATE	DESCRIPTION	BY
		REVISION	

SCALE: HOR. – VER. –
DESIGNED BY –
DRAWN BY –
CHECKED BY –
APPROVED BY –

SHEET NO.
C1.4

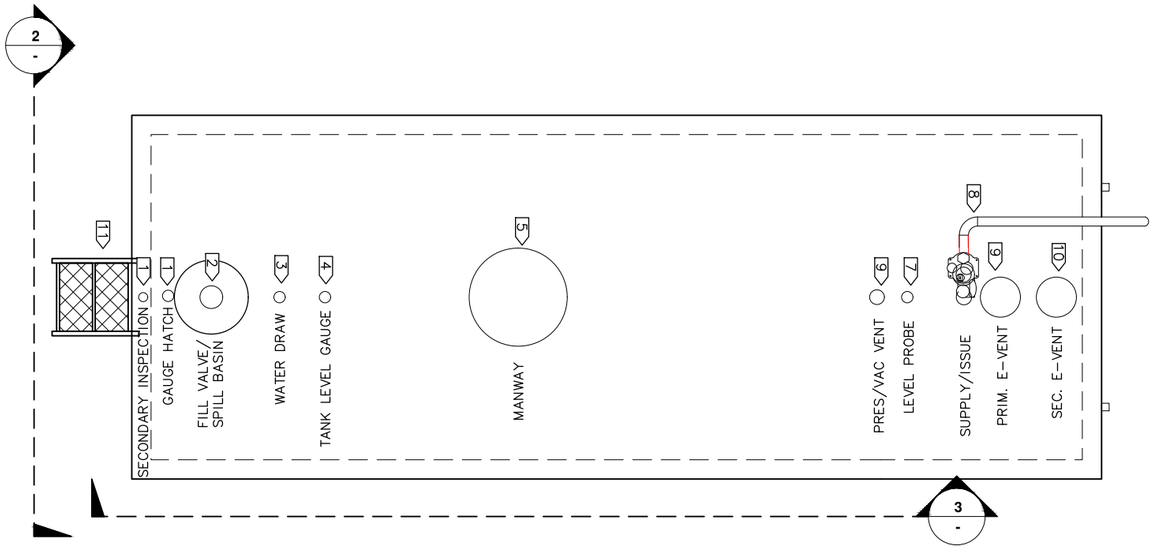
File: J:\JobsData\30416.00 Venetie Bfu Rpsu Project\001 Cadd 2019\01 Working Set\01 Civil\30416.00 Site Plan-School Tank Farm.dwg PLOT DATE: 12/10/2020 2:25 PM

SPECIFIC NOTES

1. 2" FPT (INSPECTION/GAUGE HATCH)
2. 4" THREADED PENETRATION
3. 1" WATER DRAW
4. 2" THREADED PENETRATION (TANK GAUGE INSTALLED ON 2" X 18" NIPPLE)
5. 24" MANWAY
6. 3" THREADED PENETRATION (2" PRESSURE VACUUM VENT WITH WHISTLE ALARM.) INSTALL WITH 3"X2" REDUCING BUSHING AT ELEVATION SHOWN. SET WHISTLE ALARM TO 90% FULL.
7. 3" FLANGED PENETRATION (2" LEVEL SENSOR PROBE SWITCH, SEE ELECTRICAL)
8. 4" THREADED SUPPLY
9. 8" FLANGED PRIMARY E-VENT.
10. 8" FLANGED SECONDARY E-VENT
11. SHOP FABRICATED BOLT ON LADDER
12. ACTUATED BALL VALVE (SEE SCHEDULE IN MECH)
13. ANCHOR SKID TO CONCRETE TANK FOOTING, (SEE NOTE 3)

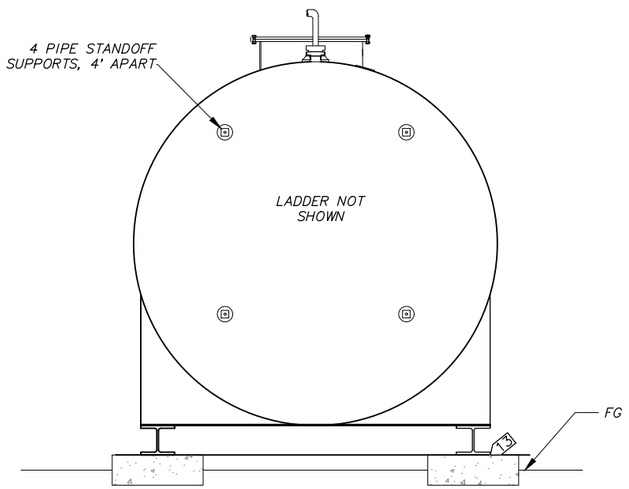
GENERAL NOTES

1. TANK SHALL BE A NEW UL 142 LISTED AND LABELED 8.0'ø x 21'-4" LONG, HORIZONTAL, DOUBLE WALL AST AS DETAILED.
2. TANKS LOCATED AT THE PROPOSED VILLAGE OF VENETIE TANK FARM WILL BE SUPPLIED WITH SUBMERSIBLE PUMPS.



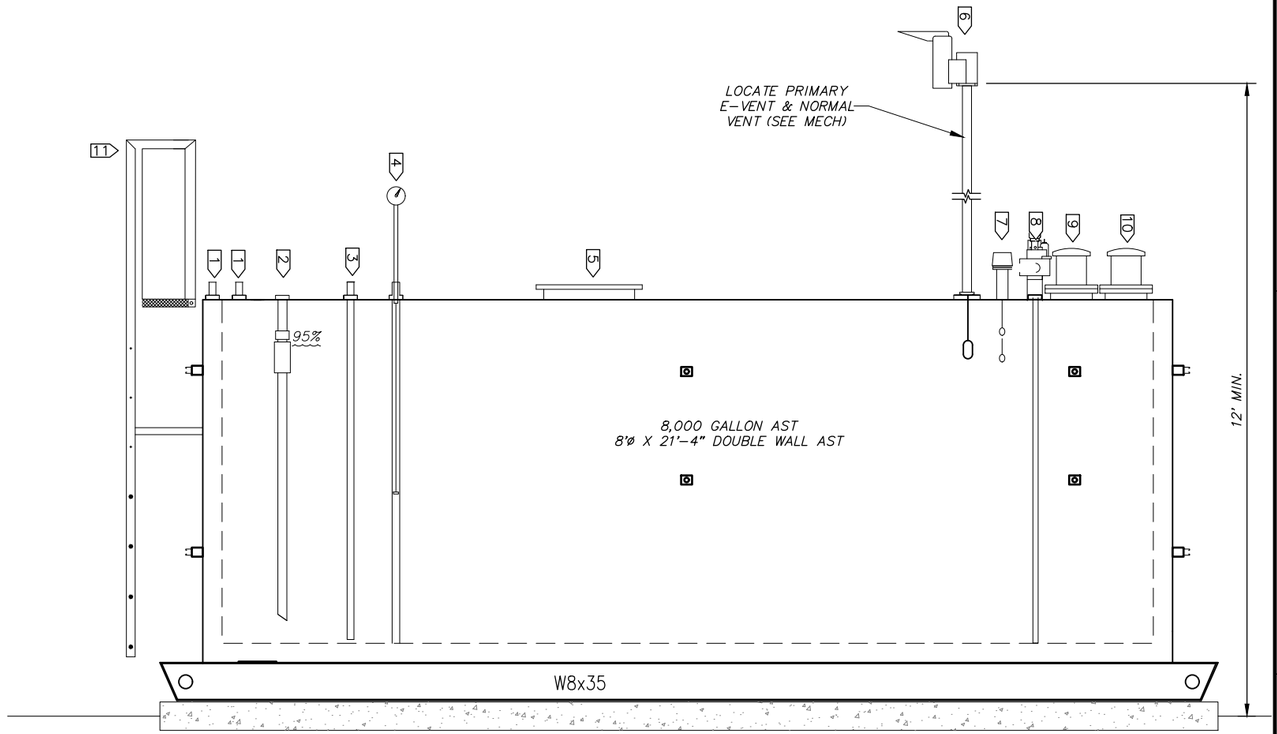
1 **PLAN - 8,000 GALLON DOUBLE WALL TANK**

NTS



2 **END ELEVATION - 8,000 GALLON DOUBLE WALL TANK**

NTS



3 **ELEVATION - 8,000 GALLON DOUBLE WALL TANK**

NTS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE (907) 677-3520
AECC-883-24

PROJECT NO. 30416.00
CITY GRID -
WATER GRID -
SEWER GRID -

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
8,000 GALLON TANK DETAILS

DATE: DEC 2020

PROJECT NO: -

STATUS: 35% DESIGN DRAWINGS

REV	DATE	DESCRIPTION	REVISION	BY

SCALE HOR. - - VER.
DESIGNED BY -
DRAWN BY -
CHECKED BY -
APPROVED BY -

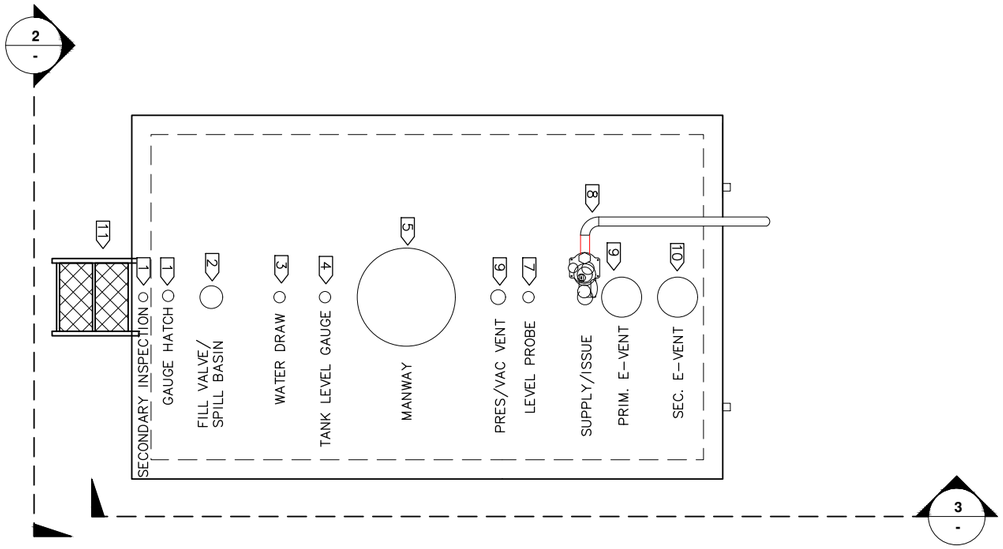
SHEET NO.
C2.1

SPECIFIC NOTES

1. 2" FPT (INSPECTION/GAUGE HATCH)
2. 4" THREADED PENETRATION
3. 1" WATER DRAW
4. 2" THREADED PENETRATION (TANK GAUGE INSTALLED ON 2" X 18" NIPPLE)
5. 24" MANWAY
6. 3" THREADED PENETRATION (2" PRESSURE VACUUM VENT WITH WHISTLE ALARM.) INSTALL WITH 3"X2" REDUCING BUSHING AT ELEVATION SHOWN. SET WHISTLE ALARM TO 90% FULL.
7. 3" FLANGED PENETRATION (2" LEVEL SENSOR PROBE SWITCH, SEE ELECTRICAL)
8. 4" THREADED SUPPLY
9. 8" FLANGED PRIMARY E-VENT.
10. 8" FLANGED SECONDARY E-VENT
11. SHOP FABRICATED BOLT ON LADDER
12. ACTUATED BALL VALVE (SEE SCHEDULE IN MECH)
13. ANCHOR SKID TO CONCRETE TANK FOOTING, (SEE NOTE 3)

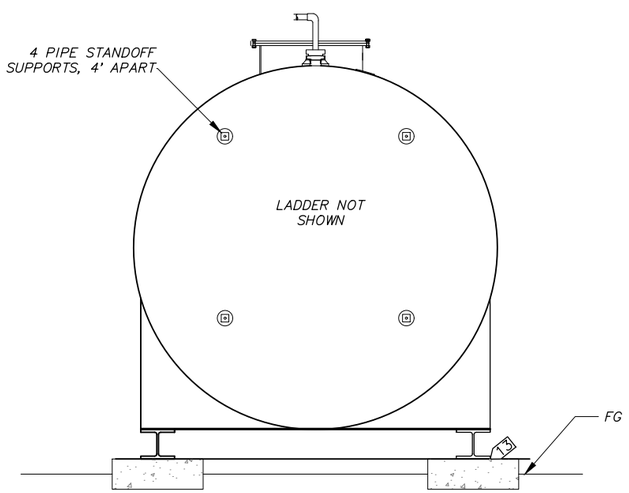
GENERAL NOTES

1. TANK SHALL BE A NEW UL 142 LISTED AND LABELED 8.0'ø x 21'-4" LONG, HORIZONTAL, DOUBLE WALL AST AS DETAILED.
2. TANKS LOCATED AT THE PROPOSED VILLAGE OF VENETIE TANK FARM WILL BE SUPPLIED WITH SUBMERSIBLE PUMPS.



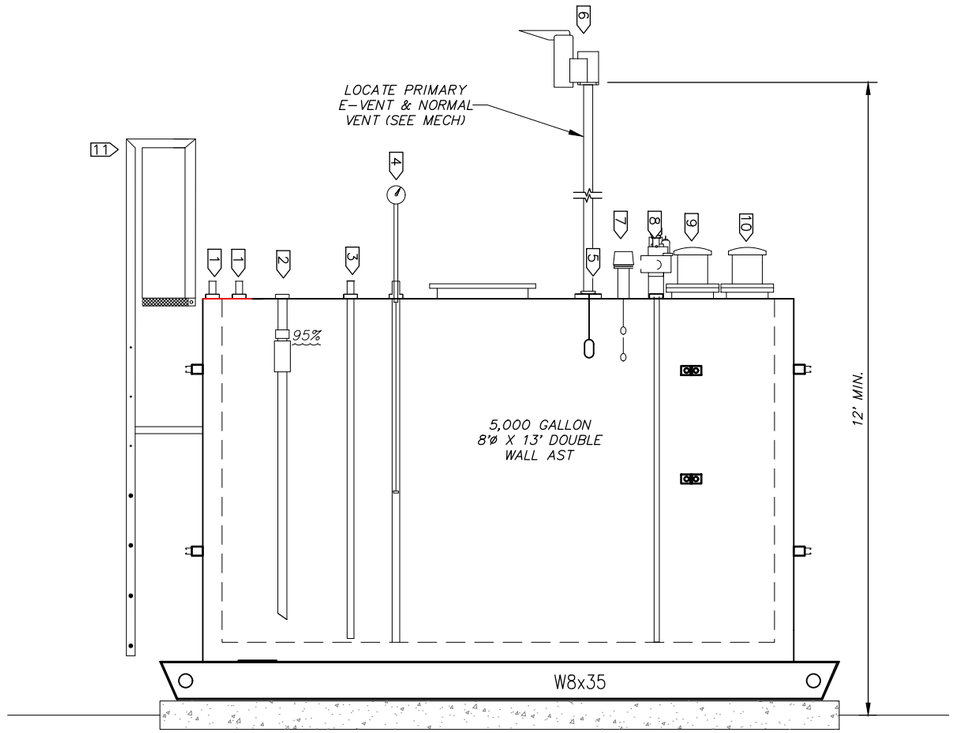
1 **PLAN - 5,000 GALLON DOUBLE WALL TANK**

NTS



2 **END ELEVATION - 5,000 GALLON DOUBLE WALL TANK**

NTS



3 **ELEVATION - 5,000 GALLON DOUBLE WALL TANK**

NTS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 677-3520
AECC-1283-24

PROJECT NO. 30416.00
CITY GRID -
WATER GRID -
SEWER GRID -

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
5,000 GALLON TANK DETAILS

DATE: DEC 2020
STATUS: 35% DESIGN DRAWINGS

PROJECT NO: -

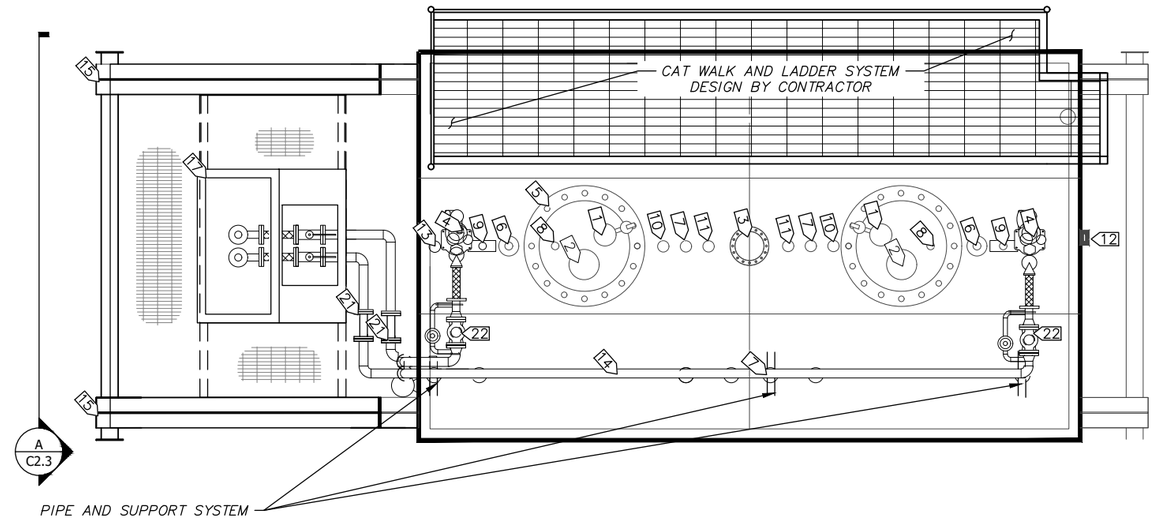
REV	DATE	DESCRIPTION	BY
REVISION			

SCALE: -
HOR. -
VER. -
DESIGNED BY -
DRAWN BY -
CHECKED BY -
APPROVED BY -

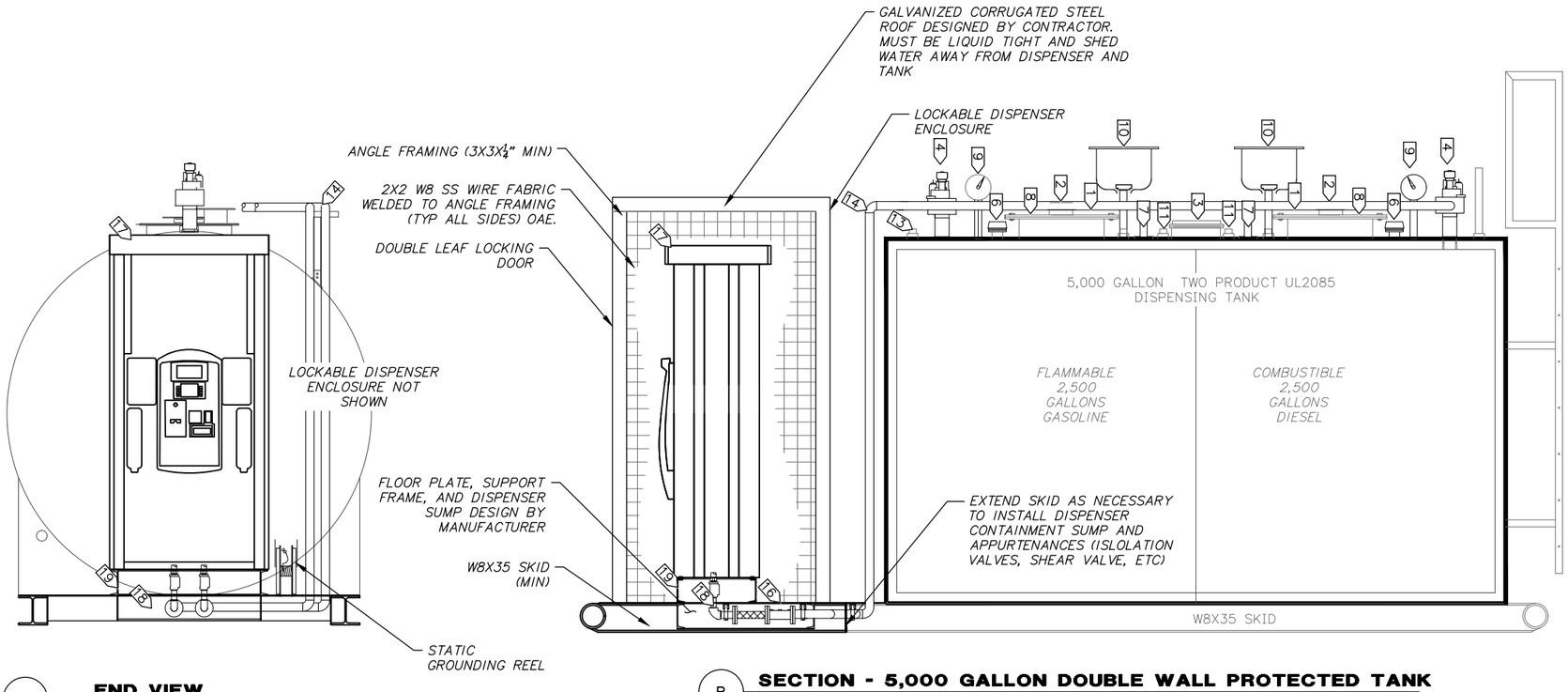
SHEET NO.
C2.2

SPECIFIC NOTES:

1. 3" FPT – PRESSURE VACUUM VENT W/ WHISTLE ALARM
2. 6" FLANGED – PRIMARY E-VENT
3. 8" FLANGED – SECONDARY E-VENT
4. 4" FPT – SUBMERSIBLE PUMP
5. 24" MANHOLE
6. 3" FLANGED – FLOATS (BY OTHERS)
7. 2" FPT – WATER DRAW
8. 2" FPT – SPARE
9. 2" FPT – CLOCK GAUGE
10. 4" FPT – 6 GALLON FILL BUCKET W/ FILL LIMITER AND DROP TUBE
11. 4" FPT – SPARE
12. (NOT USED)
13. 2" FPT – GAUGE HATCH
14. 2" SCHEDULE 80 STEEL PIPING
15. SKID EXTENSIONS
16. DISPENSER FLOOR PLATE
17. DUAL PRODUCT DISPENSER
18. DISPENSER CONNECTIVE PIPING
19. CONTAINMENT SUMP
20. PIPE SUPPORT (NOT USED)
21. 2" STRAINER
22. 2" BALL VALVE WITH 1" PRV



1 PLAN - 5,000 GALLON DOUBLE WALL PROTECTED TANK
SCALE: NTS



A END VIEW
SCALE: NTS

B SECTION - 5,000 GALLON DOUBLE WALL PROTECTED TANK
SCALE: NTS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907)677-3520
FAX: (907)677-3522

STATE OF ALASKA – 49TH – KEITH HUBER – CE-10583 – REGISTERED PROFESSIONAL ENGINEER

PROJECT NO. 30416.00
CITY GRID: –
WATER GRID: –
SEWER GRID: –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

5,000 GALLON TWO PRODUCT DISPENSING TANK

DATE: DEC 2020

STATUS: 35% DESIGN DRAWINGS

PROJECT NO:-

REV	DATE	DESCRIPTION	BY
		REVISION	

SCALE: – | VER. –
DESIGNED BY –
DRAWN BY –
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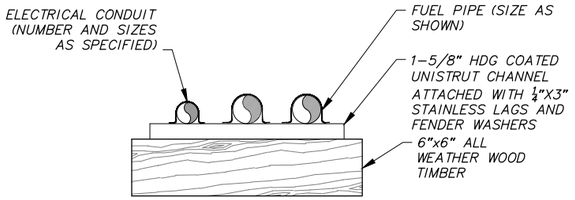
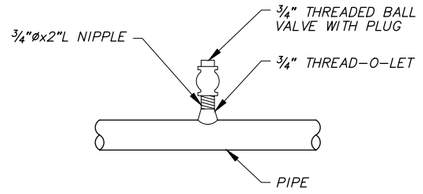
APPROVED BY –

SHEET NO.
C2.3



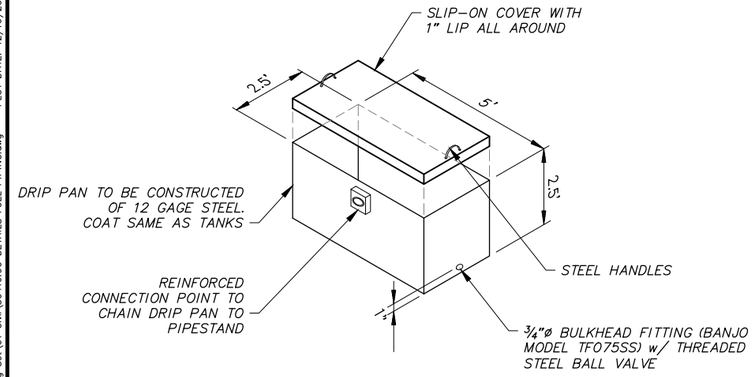
1 TIMBER PIPE SUPPORT

SCALE: NTS



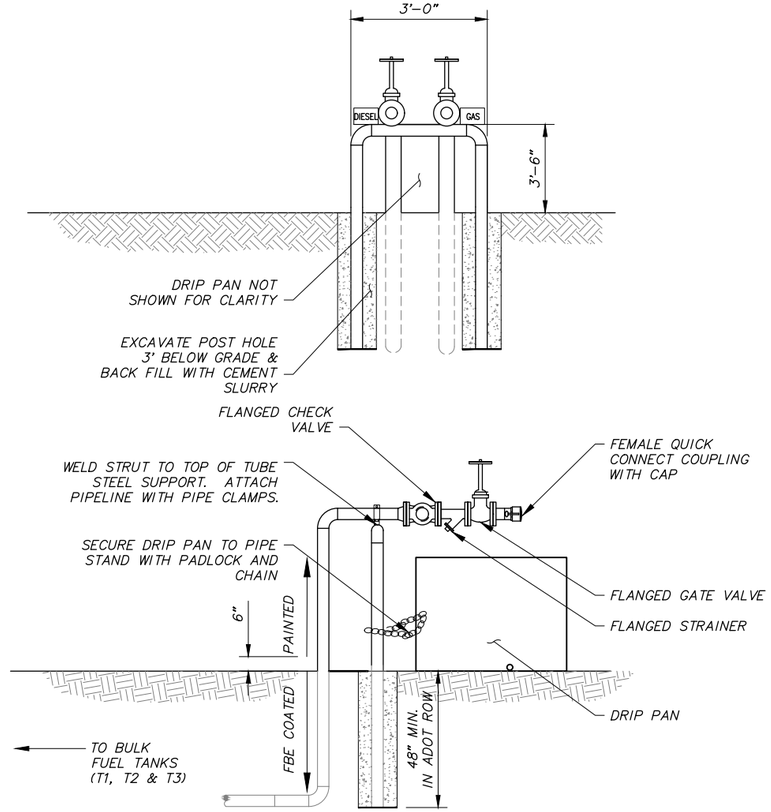
2 PRESSURE TEST PORT

SCALE: NTS



3 DRIP PAN

SCALE: NTS



4 AIR TANKER HEADER

SCALE: NTS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE (907) 677-3252
#AECL883-24

PROJECT NO. 30416.00
CITY GRID -
WATER GRID -
SEWER GRID -

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

FUEL PIPING DETAILS

DATE: DEC 2020

PROJECT NO: -

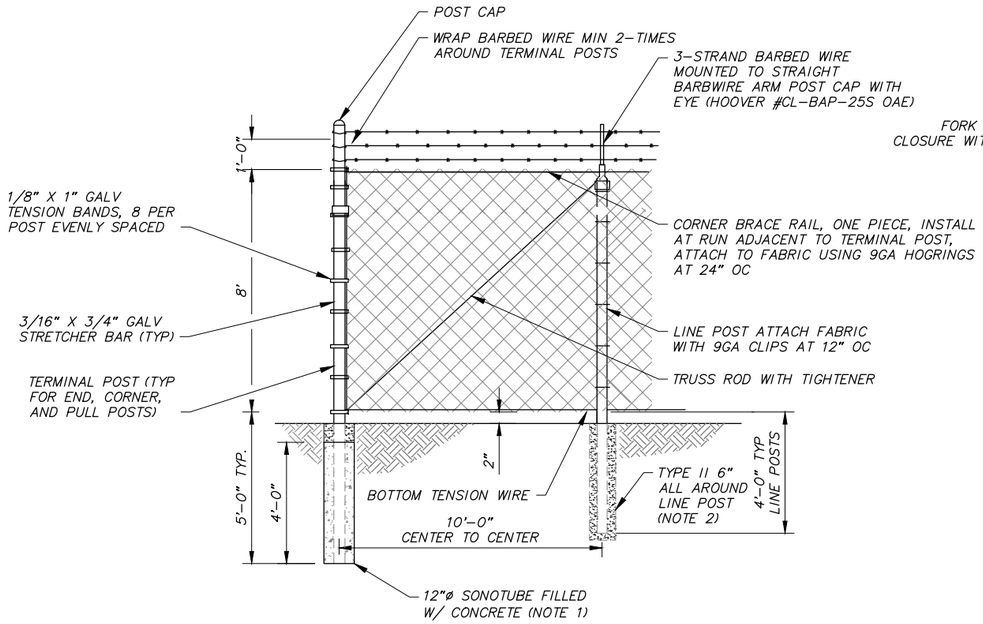
STATUS: 35% DESIGN DRAWINGS

REV	DATE	DESCRIPTION	BY
REVISION			

SCALE HOR. - VER. -
DESIGNED BY -
DRAWN BY -
CHECKED BY -
APPROVED BY -

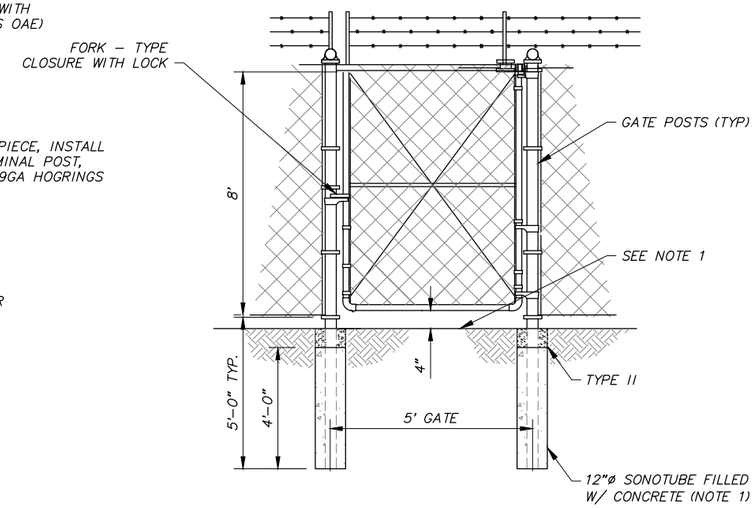
SHEET NO.

C2.4



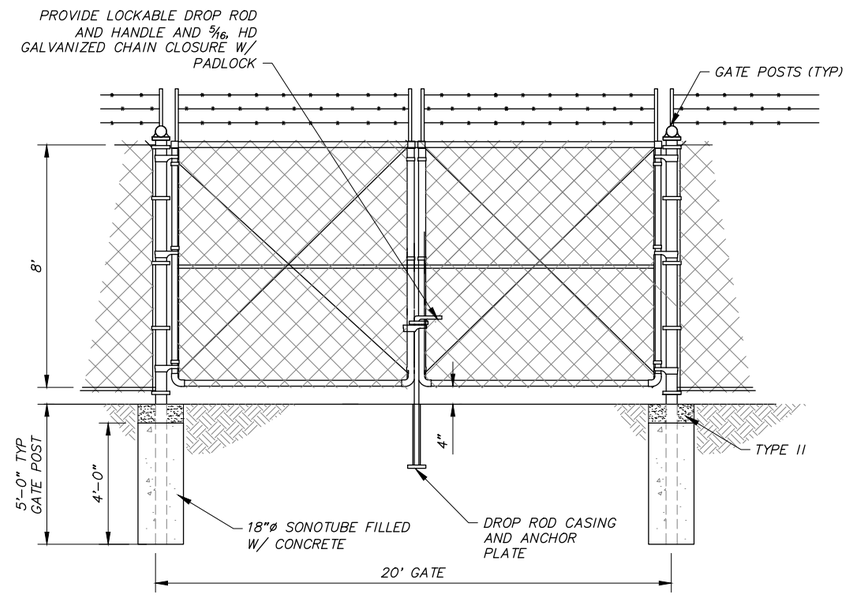
1 FENCE DETAIL

SCALE: NTS



2 MAN GATE DETAIL

SCALE: NTS



3 20-FOOT DOUBLE SWING GATE DETAIL

SCALE: NTS

NOTES

1. IF CORNER, PULL OR GATE FENCE POSTS ENCOUNTER BEDROCK PRIOR TO FULL EMBEDMENT PERFORM ROCK EXCAVATION/DRILLING TO ATTAIN FULL DEPTH AND INSTALL CONCRETE AS SHOWN ON DRAWINGS.
2. IF LINE POSTS ENCOUNTER BEDROCK PRIOR TO FULL EMBEDMENT CONTRACTOR SHALL PERFORM ROCK EXCAVATION/DRILLING TO ATTAIN FULL DEPTH. ALTERNATIVELY CONTACTOR MAY ANCHOR LINE POSTS WITHIN 12"øx36" LONG CONCRETE FILLED SONOTUBE SO LONG AS A MINIMUM 3' EMBEDMENT CAN BE ATTAINED.

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE (907) 677-3520
#AECL883-24

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

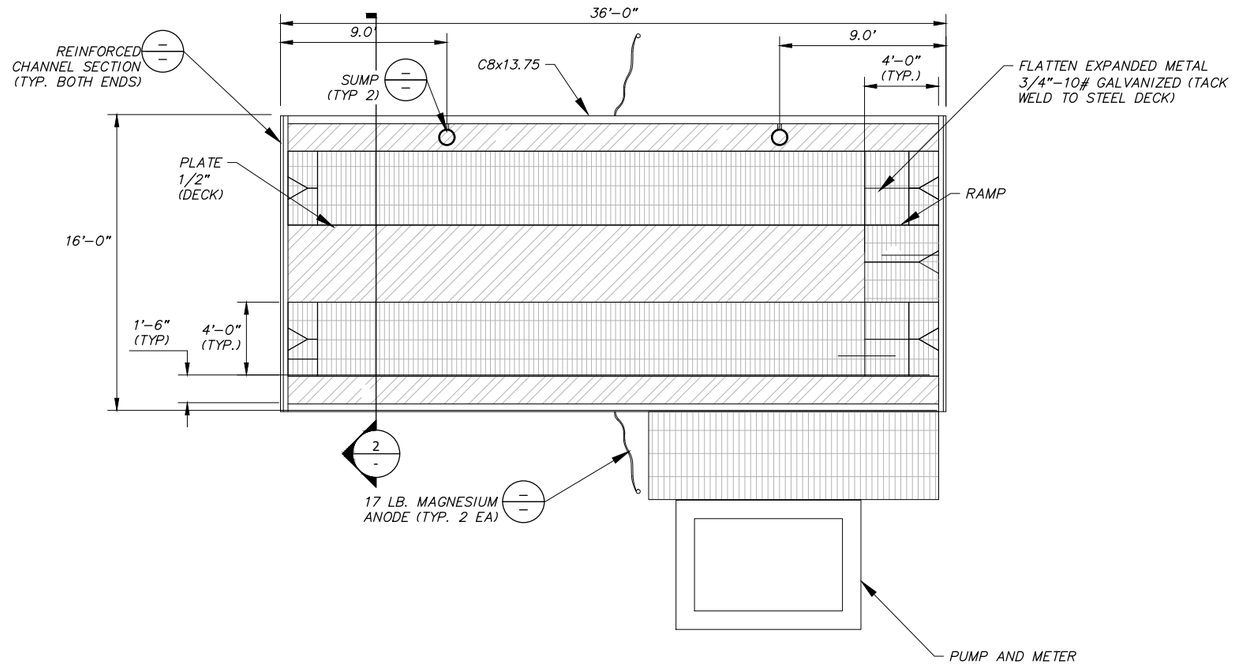
VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
FENCE DETAILS

DATE: DEC 2020
STATUS: 35% DESIGN DRAWINGS
PROJECT NO: –

REV	DATE	DESCRIPTION	BY
REVISION			

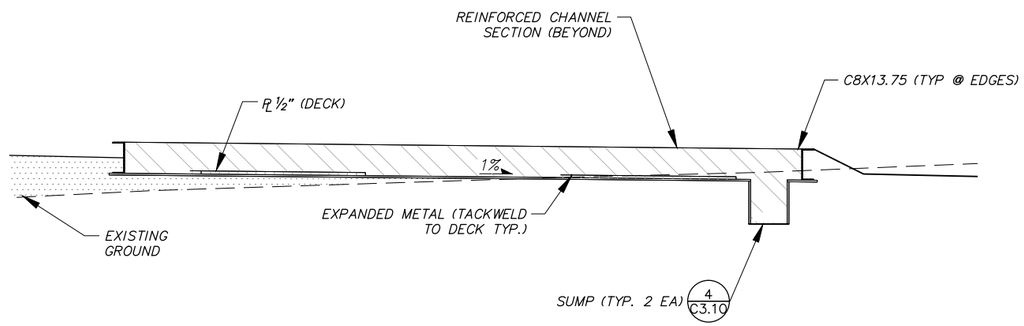
SCALE HOR. – VER. –
DESIGNED BY –
DRAWN BY –
CHECKED BY –
APPROVED BY –

SHEET NO.
C2.5



1 DRIVE IN TRUCK CONTAINMENT PLAN

SCALE: NTS



2 DRIVE IN TRUCK CONTAINMENT SECTION VIEW

SCALE: NTS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL883-24

PROJECT NO. 30416.00 | CITY GRID – | WATER GRID – | SEWER GRID –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

TRUCK CONTAINMENT DETAILS

DATE: DEC 2020

STATUS: 35% DESIGN DRAWINGS

PROJECT NO: –

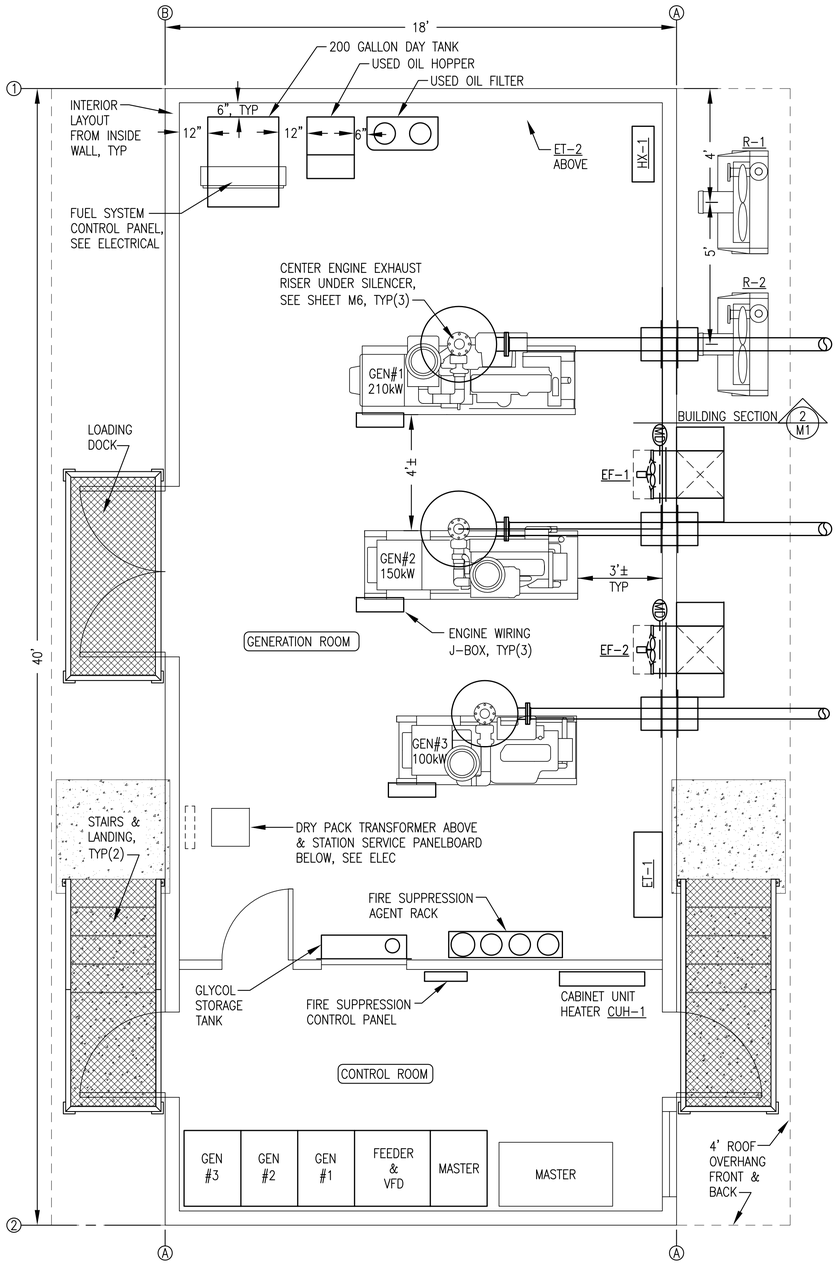
REV	DATE	DESCRIPTION	BY
REVISION			

SCALE HOR. – VER. –
DESIGNED BY –
DRAWN BY –
CHECKED BY –
APPROVED BY –

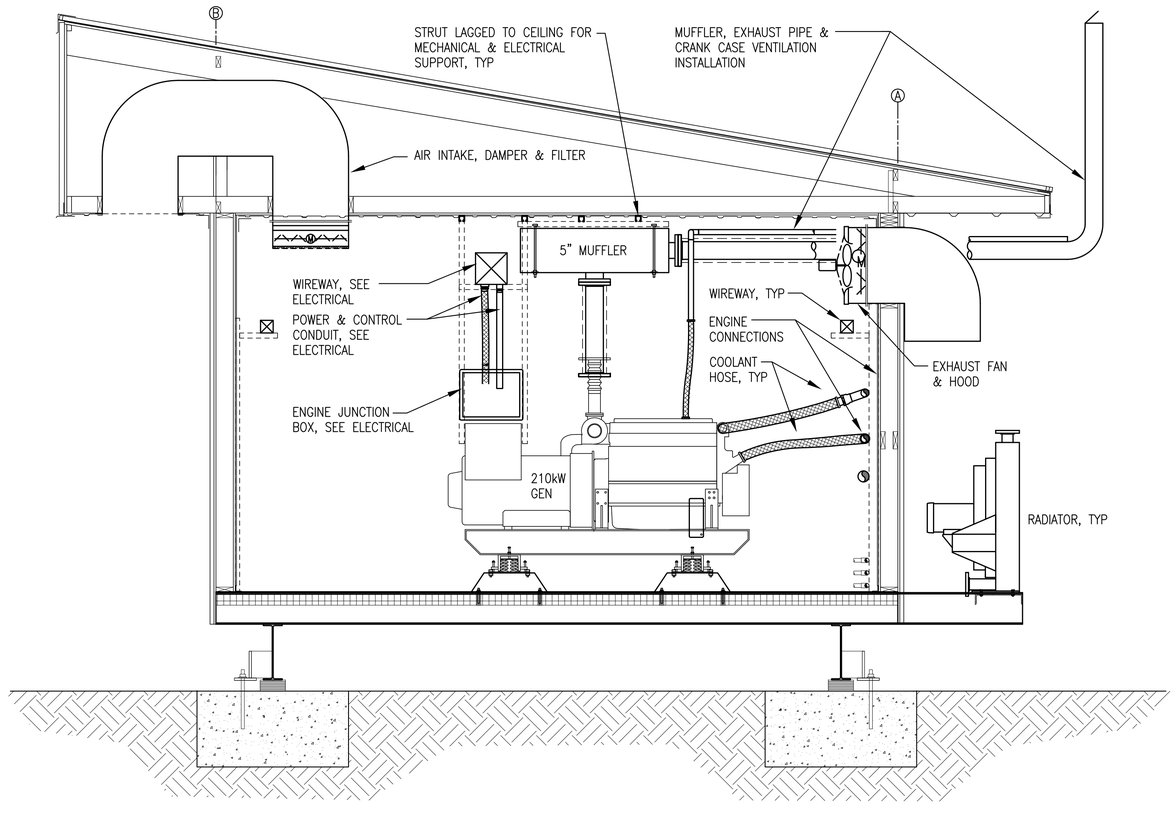
SHEET NO.

C2.6

File: J:\JobsData\30416.00 Venetie Btu Rpsu Project\001 Cadd 2019\01 Working Set\01 Civil\30416.00 DETAILS TRUCK CONTAINMENT.dwg PLOT DATE: 12/10/2020 2:25 PM



1 M1 EQUIPMENT LAYOUT PLAN
1/2"=1'-0"



2 M1 BUILDING SECTION
1/2"=1'-0"

ALASKA ENERGY AUTHORITY

CRW ENGINEERING GROUP LLC
PHONE: (907) 562-3252

Gray Stassel Engineering, Inc.
PHONE: (907) 349-0100

VENETIE, ALASKA
POWER SYSTEM UPGRADE PROJECT

POWER PLANT
EQUIPMENT LAYOUT PLAN & SECTION

NO.	REVISION	BY	DATE

Plot Date 12/20
Designed BCG
Drawn JTD
Approved BCG

Sheet No.
M1

GENERAL NOTES

1. ALL CONSTRUCTION WORK SHALL BE DONE IN ACCORDANCE WITH THE STAKING SHEETS, NOTES TO STAKING SHEETS, SPECIFICATIONS, AND THE CONSTRUCTION DRAWINGS.

2. THE 2007 EDITION OF ANSI C2 – NATIONAL ELECTRICAL SAFETY CODE (NESC), RUS BULLETIN 1728F-804, SPECIFICATIONS AND DRAWINGS FOR 12.47/7.2 kV LINE CONSTRUCTION, AND RUS BULLETIN 1728F-806, SPECIFICATIONS AND DRAWINGS FOR UNDERGROUND ELECTRICAL DISTRIBUTION, UNLESS MODIFIED BY THESE DRAWINGS OR SPECIFICATIONS, SHALL BE FOLLOWED, INCLUDING ANY STATE OF ALASKA AMENDMENTS. OBTAIN COPIES OF THE RUS BULLETINS AND MAINTAIN COPIES ON THE JOB SITE. ADDITIONALLY, CONSTRUCTION SPECIFICATIONS ARE INCLUDED IN DIVISIONS 26 AND 33 OF THE CONSTRUCTION DOCUMENTS. CONTRACTOR SHALL BE THOROUGHLY FAMILIAR WITH THE CONTRACT DOCUMENTS, RUS CONSTRUCTION UNITS, AND ANSI C2.

3. THE EXISTING ELECTRICAL DISTRIBUTION SYSTEM CURRENTLY SERVES CUSTOMERS. SERVICE SHALL BE MAINTAINED AT ALL TIMES TO THE CUSTOMERS EXCEPT WHEN OUTAGES ARE REQUIRED FOR SERVICE CONVERSION OR OTHER CONSTRUCTION RELATED ACTIVITIES. ALL OUTAGES SHALL BE COORDINATED IN ADVANCE WITH THE VENETIE VILLAGE ELECTRIC (OWNER). PRIOR TO COMMENCING WORK ON THE UPGRADE, MEET WITH THE VENETIE VILLAGE ELECTRIC TO DEVELOP AN OUTAGE SCHEDULE THAT WILL KEEP DISRUPTIONS OF POWER TO THE CUSTOMERS TO A MINIMUM. VENETIE VILLAGE ELECTRIC SHALL HAVE FINAL AUTHORITY ON WHEN OUTAGES CAN OCCUR.

4. THE EXISTING ELECTRICAL DISTRIBUTION SYSTEM POLES ARE SHARED WITH THE TELEPHONE SYSTEM, UNITED UTILITY, INC. CONTRACTOR SHALL NOT DISRUPT THE EXISTING TELEPHONE SYSTEM WITHOUT THE CONSENT OF THE TELEPHONE COMPANY. ANY PART OF THE EXISTING TELEPHONE SYSTEM DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED OR REPLACED AS DIRECTED BY THE TELEPHONE COMPANY.

5. UNLESS OTHERWISE INDICATED, THE EXISTING PRIMARY AND SECONDARY DISTRIBUTION SYSTEM, INCLUDING HARDWARE, CONDUCTORS (BOTH PRIMARY AND SECONDARY), TRANSFORMERS, CROSSARMS, INSULATORS, LIGHTS, ANCHOR RODS, GUYS, AND ALL OTHER MATERIAL DIRECTLY RELATED TO THE EXISTING ELECTRICAL DISTRIBUTION SYSTEM SHALL BE REMOVED AFTER COMPLETION OF THE INSTALLATION, ENERGIZATION, AND SERVICE CONVERSIONS TO THE NEW ELECTRICAL DISTRIBUTION SYSTEM. POLES THAT HAVE TELEPHONE SYSTEM CONDUCTORS OR EQUIPMENT ATTACHED SHALL NOT BE REMOVED.

6. ALL EXISTING UTILITIES MAY NOT BE SHOWN. CONTRACTOR SHALL LOCATE ALL UNDERGROUND UTILITIES PRIOR TO DIGGING HOLES FOR POLES AND ANCHORS. COORDINATE WITH THE VILLAGE OF VENETIE AND VENETIE VILLAGE ELECTRIC TO LOCATE UNDERGROUND UTILITIES.

7. THE DRAWINGS ARE DIAGRAMMATIC AND DO NOT NECESSARILY SHOW ALL FEATURES OF THE REQUIRED WORK. PROVIDE ALL EQUIPMENT AND MATERIALS REQUIRED FOR A COMPLETE SYSTEM. VERIFY EXISTING FIELD CONDITIONS PRIOR TO STARTING CONSTRUCTION. IMMEDIATELY CONTACT THE ENGINEER FOR CLARIFICATION OF QUESTIONABLE ITEMS OR APPARENT CONFLICTS.

8. ENSURE THAT APPROPRIATE SAFETY MEASURES ARE IMPLEMENTED AND THAT ALL WORKERS ARE AWARE OF THE POTENTIAL HAZARDS FROM ELECTRICAL SHOCK ASSOCIATED WITH WORKING ON OR NEAR AN ENERGIZED MEDIUM VOLTAGE DISTRIBUTION SYSTEM.

9. THE SITE DRAWINGS USED WERE DEVELOPED USING A COMBINATION OF AERIAL PHOTOGRAPHY AND SURVEY DATA PROVIDED BY OTHERS. ANY VARIATIONS BETWEEN WHAT IS SHOWN AND THE ACTUAL FIELD CONDITIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER.

10. SEE CONSTRUCTION SPECIFICATIONS FOR ADDITIONAL INFORMATION.

11. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR COORDINATING HIS WORK WITH EXISTING FACILITY OPERATORS, OTHER CONTRACTORS AND/OR SUBCONTRACTORS WORKING IN THE COMMUNITY, LOCAL UTILITY AND GOVERNMENT ORGANIZATIONS, AND STATE AND FEDERAL AUTHORITIES.

12. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR PROVIDING CONSTRUCTION ACCESS FOR EQUIPMENT AND PERSONNEL AS REQUIRED TO COMPLETE POLE INSTALLATION, POLE HARDWARE AND CONDUCTOR INSTALLATION, AND ALL OTHER PROJECT TASKS. CONTRACTOR SHALL COORDINATION WITH LOCAL ENTITIES AND RESIDENTS, ERECT TEMPORARY STRUCTURES, AND PERFORM TEMPORARY REMOVAL/RELOCATION AND REPLACEMENT OF ALL STRUCTURES, STEAM HOUSES, ETC. AS NECESSARY TO COMPLETE THE WORK. ALL EXISTING STRUCTURES AFFECTED BY THE WORK SHALL BE RETURNED TO THEIR ORIGINAL OR BETTER CONDITION BY THE CONTRACTOR IMMEDIATELY AFTER THE CONTRACTOR'S WORK IN THAT AREA IS COMPLETED. CONTRACTOR SHALL COORDINATE ALL NECESSARY PUBLIC SAFETY ACTIVITIES INCLUDING SIGNAGE, BARRIERS, TRAFFIC CONTROL PLANS, LIGHTING, PUBLIC NOTIFICATIONS, AND OTHER ITEMS DEEMED NECESSARY TO PROTECT THE PUBLIC DURING CONSTRUCTION ACTIVITIES.

13. THE CONTRACTOR SHALL BALANCE THE PHASES OF THE NEW DISTRIBUTION SYSTEM. DURING CONSTRUCTION LOAD IMBALANCE SHOULD BE KEPT TO A MINIMUM AND SHALL NOT EXCEED 10%. .

SCOPE OF WORK

1. THE PURPOSE OF THIS PROJECT IS TO REPLACE THE EXISTING ELECTRICAL DISTRIBUTION SYSTEM IN VENETIE, ALASKA, AS INDICATED ON THE DRAWINGS.

2. THE LIMIT OF CONSTRUCTION FOR THE NEW ELECTRICAL DISTRIBUTION SYSTEM IS THE CONNECTION TO THE EXISTING SERVICE MASTS AT THE VARIOUS SERVICES. THE CONTRACTOR SHALL REMOVE THE EXISTING SECONDARY SERVICE DROP CONDUCTORS, UNLESS OTHERWISE INDICATED ON THE DRAWINGS, AND INSTALL NEW SERVICE CONDUCTORS TO EACH SERVICE. THE EXISTING METER BASE OR SERVICE MAST WILL NOT BE THE RESPONSIBILITY OF THE CONTRACTOR EXCEPT FOR PROVIDING DEADEND ASSEMBLIES AND MAKING THE CONNECTION TO THE EXISTING SERVICE ENTRANCE CONDUCTORS AT THE SERVICE MAST. IF THE EXISTING SERVICE MAST IS NOT IN SATISFACTORY CONDITION TO SUPPORT THE NEW SERVICE, THE CONTRACTOR SHALL NOTIFY VENETIE VILLAGE ELECTRIC FOR RESOLUTION. THE CONTRACTOR SHALL NOTIFY VENETIE VILLAGE ELECTRIC FAR ENOUGH IN ADVANCE TO ALLOW VENETIE VILLAGE ELECTRIC TIME TO REPAIR OR REPLACE THE SERVICE MAST.

COORDINATION BETWEEN NEW AND EXISTING DISTRIBUTION SYSTEMS

1. THE NEW ELECTRICAL DISTRIBUTION SYSTEM WILL CROSS THE EXISTING ELECTRICAL DISTRIBUTION SYSTEM AT MULITIPLE LOCATIONS AS INDICATED ON THE DRAWINGS, BUT NOT LIMITED TO THE LOCATIONS SHOWN. AT ALL CROSSINGS THE CONTRACTOR SHALL MAKE PROVISIONS IN THE EXISTING AND/OR NEW ELECTRICAL DISTRIBUTION SYSTEMS TO MAINTAIN POWER TO THE CUSTOMERS DURING THE CONSTRUCTION OF THE NEW SYSTEM. AS INDICATED, ALL OUTAGES SHALL BE COORDINATED WITH AND APPROVED BY THE VENETIE VILLAGE ELECTRIC. ACCEPTABLE METHODS WILL BE AS FOLLOWS:

   a) WHERE THE NEW OVERHEAD DISTRIBUTION SYSTEM IS HIGHER THAN THE EXISTING SYSTEM, CONTRACTOR MAY LOWER THE NEUTRAL OF THE NEW SYSTEM SUCH THAT THE PRIMARY CONDUCTORS OF THE NEW SYSTEM CROSS OVER THE EXISTING SYSTEM AND THE NEUTRAL CROSSES UNDER.

   b) CONTRACTOR MAY INSTALL TEMPORARY INSULATED MEDIUM VOLTAGE CONDUCTORS AND ROUTE THE CONDUCTORS ON THE GROUND. IF THIS METHOD IS CHOSEN, THE AT-GRADE CONDUCTORS SHALL BE PROTECTED FROM VANDALISM AND DAMAGE AND PROVISIONS SHALL BE MADE FOR THE SUPPORT OF THE EXISTING POLES DURING THE INSTALLATION OF THE NEW SYSTEM.

   c) OTHER METHODS MAY BE PROPOSED BY THE CONTRACTOR AS APPLICABLE TO ALLOW INSTALLATION OF THE NEW SYSTEM WHILE THE EXISTING SYSTEM REMAINS IN SERVICE.

2. IN ALL CASES, THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE BEST METHOD OF CROSSING THE EXISTING DISTRIBUTION SYSTEM. THE CONTRACTOR SHALL PROVIDE ALL MATERIAL REQUIRED TO ACCOMPLISH ALL CROSSINGS.

3. AT ALL TIMES AND IN ALL LOCATIONS, TEMPORARY INSTALLATIONS SHALL MEET THE NESC SAFETY REQUIREMENTS. ANY TEMPORARY INSTALLATION THAT IS ROUTED ON THE GROUND SHALL BE CLEARLY IDENTIFIED AND, IF REQUIRED, PROVISIONS SHALL BE INSTALLED FOR PERSONNEL AND VEHICLE CROSSING.

ELECTRICAL EQUIPMENT SCHEDULE

ITEM NO.	DESCRIPTION	MANUFACTURER
1	STREET LIGHT, LED TYPE, POLE MOUNTED WITH ARM AND ATTACHMENTS. TYPE II LIGHT DISTRIBUTION. 4000K CCT, GRAY. PROVIDE 2-1/2' LONG GALVANIZED, 2" PIPE TENON CANTILEVER ARM SUITABLE FOR WOOD POLES. 120 VOLTS. PHOTO ELECTRIC CONTROL.	AMERICAN ELECTRIC LIGHTING CAT. No. ATBO 20LEDE70 MVOLT R2 PCSS LITHONIA SMAW-T20-US2-5-GALV TENON ARM
2	STREET LIGHT, LED TYPE, POLE MOUNTED WITH ARM AND ATTACHMENTS. TYPE IV LIGHT DISTRIBUTION. 4000K CCT, GRAY. PROVIDE 2-1/2' LONG GALVANIZED, 2" PIPE TENON CANTILEVER ARM SUITABLE FOR WOOD POLES. 120 VOLTS. PHOTO ELECTRIC CONTROL.	AMERICAN ELECTRIC LIGHTING CAT. No. ATBO 20LEDE70 MVOLT R2 PCSS LITHONIA SMAW-T20-US2-5-GALV TENON ARM
3	120/240 VOLT, SINGLE-PHASE, THREE-WIRE, 100 AMP, OVERHEAD METER MAIN BASE WITH 100 AMP MAIN CIRCUIT BREAKER. FORM 2S WITH 304 STAINLESS STEEL ENCLOSURE. PROVIDE AW HUB. SERVICE ENTRANCE RATED.	B-LINE CAT. No. 1M1R-SS

ABBREVIATIONS

(E)	EXISTING
A	AMPERE
AC	ALTERNATING CURRENT
AIC	AMPERES INTERRUPTING CAPACITY
AWG	AMERICA WIRE GAGE
BCu	BARE COPPER
C	CONDUCTOR
C	CONDUIT
CB	CIRCUIT BREAKER
CIC	CABLE IN CONDUIT
CT	CURRENT TRANSFORMER
DIA	DIAMETER
DISC	DISCONNECT
DWG	DRAWING
EA	EACH
EL	ELEVATION
F	FAHRENHEIT
FT	FEET
FU	FUSE
G,GND	GROUND
H	HOT CONDUCTOR
HDPE	HIGH DENSITY POLYETHYLENE
HPS	HIGH PRESSURE SODIUM
HZ	HERTZ
JCN	JACKETED CONCENTRIC NEUTRAL
KVA	KILOVOLT-AMPERES
KW	KILOWATT
LFMC	LIQUID-TIGHT FLEXIBLE METAL CONDUIT
LFNC	LIQUID-TIGHT FLEXIBLE NON-METALLIC CONDUIT
LTG	LIGHTING
M	METER
MAX	MAXIMUM
MCM	THOUSAND CIRCULAR MILLS
MFR	MANUFACTURER
MIN	MINIMUM
N	NEUTRAL CONDUCTOR
NTS	NOT TO SCALE
P	POLE
PED	SECONDARY SERVICE PEDESTAL
PDS	PRIMARY DISTRIBUTION SWITCHGEAR
PH	PHASE
PVC	POLYVINYL CHLORIDE
R	SHUNT REACTOR
RMC	RIGID METAL CONDUIT, GALVANIZED
TR	TRANSFORMER
TYP	TYPICAL
UD	UNDERGROUND DISTRIBUTION
U/G	UNDERGROUND
UON	UNLESS OTHERWISE NOTED
USGS	UNITED STATES GEOLOGICAL SURVEY
V	VOLTS
VA	VOLT-AMPERES
VAC	VOLTS-ALTERNATING CURRENT
W	WATTS
WP	WEATHERPROOF
XFMR	TRANSFORMER
XLP	CROSS LINKED POLYETHYLENE

LEGEND

EXISTING	NEW
EXISTING SINGLE PHASE OVERHEAD PRIMARY	NEW SINGLE PHASE OVERHEAD PRIMARY
EXISTING 3-PHASE OVERHEAD PRIMARY	NEW 3-PHASE OVERHEAD PRIMARY
EXISTING UNDERGROUND	NEW UNDERGROUND
EXISTING SECONDARY*	NEW SECONDARY*
EXISTING ELECTRICAL POLE	NEW ELECTRICAL POLE
EXISTING STUB POLE	NEW STUB POLE
EXISTING TRANSFORMER XX=SIZE	NEW TRANSFORMER XX=SIZE
EXISTING GUY	NEW GUY
EXISTING LIGHT	NEW LIGHT

*SINGLE PHASE UNLESS NOTED ON THE DRAWINGS

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PROJECT NO. 30416.00 | CITY GRID – | WATER GRID – | SEWER GRID –

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
DISTRIBUTION LEGEND, ABBREVATIONS, SPECIFICATIONS & NOTES

DATE: DEC 2020
STATUS: 35% DESIGN DRAWINGS

REV | DATE | DESCRIPTION | REVISION | BY

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SHEET NO. E1.0

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FAX (907) 677-3522

PROJECT NO. 30416.00
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SEWER GRID –

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
DISTRIBUTION SITE PLAN

DATE: DEC 2020

PROJECT NO: –

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NOTES

1. DEMOLISH ALL EXISTING DISTRIBUTION CONDUCTORS, CROSSARMS, HARDWARE, ETC. TAKEN OUT OF SERVICE AS A RESULT OF THIS PROJECT EXCEPT WHERE SPECIFICALLY INDICATED TO REMAIN. COORDINATE DEMO WORK TO MINIMIZE OUTAGES.
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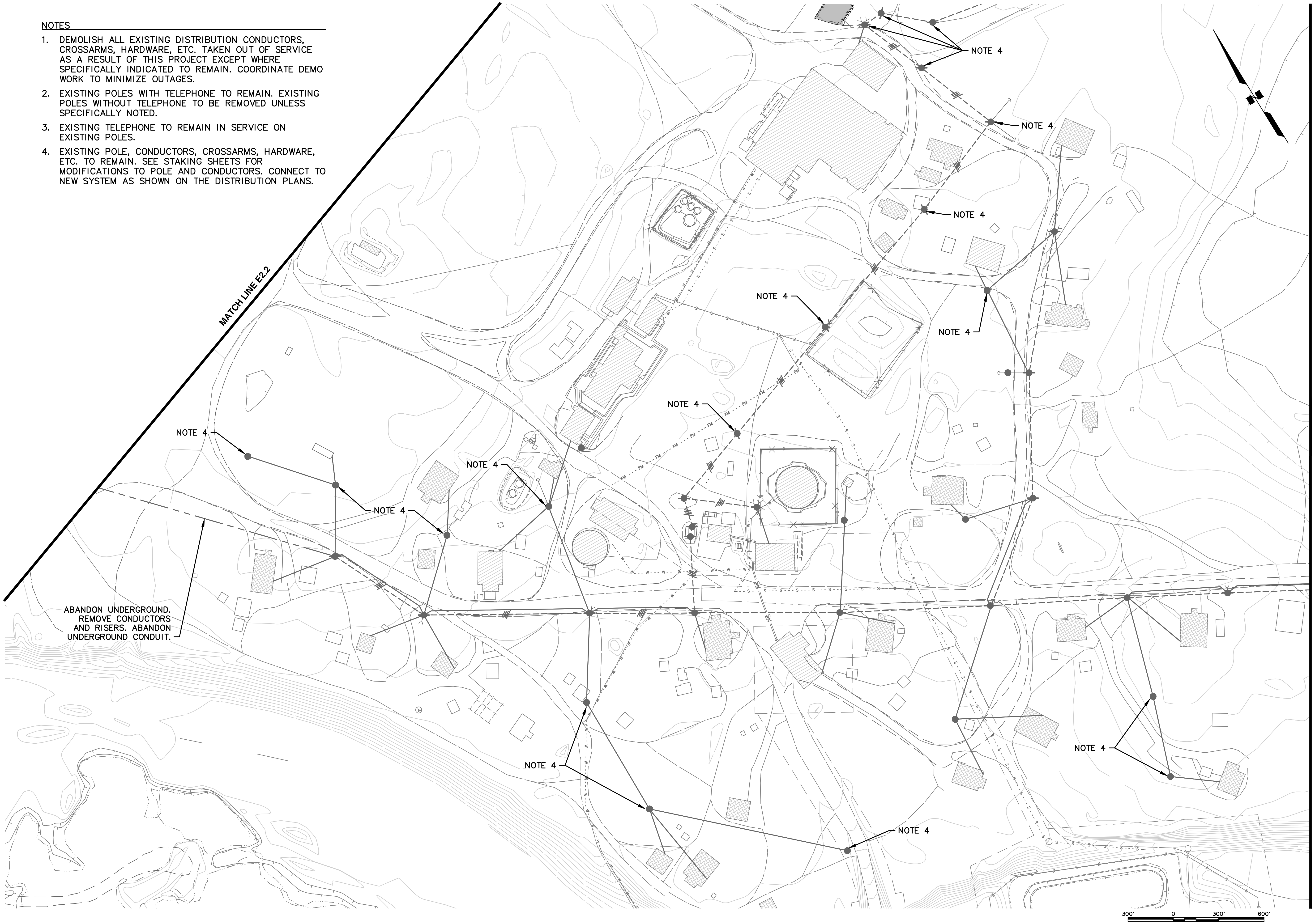

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PROJECT NO. 30416.00
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SEWER GRID –

PROJECT NO: –

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
DEMOLITION PLAN
(1 of 9)

STATUS: 35% DESIGN DRAWINGS
DATE: DEC 2020

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NOTES

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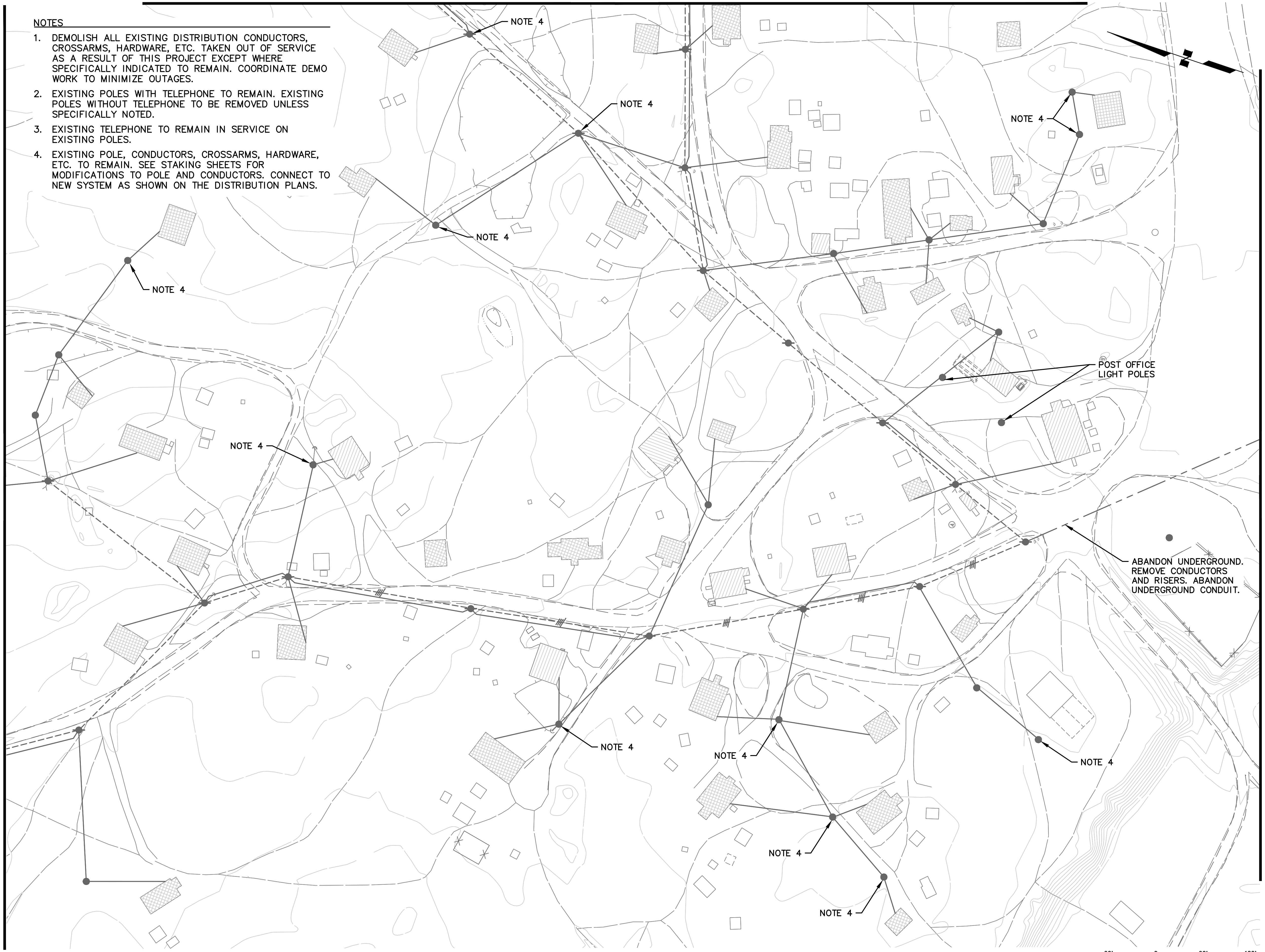

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PROJECT NO. 30416.00
CITY GRID –
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SEWER GRID –

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
DEMOLITION PLAN
(2 of 9)

PROJECT NO: –
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E2.2

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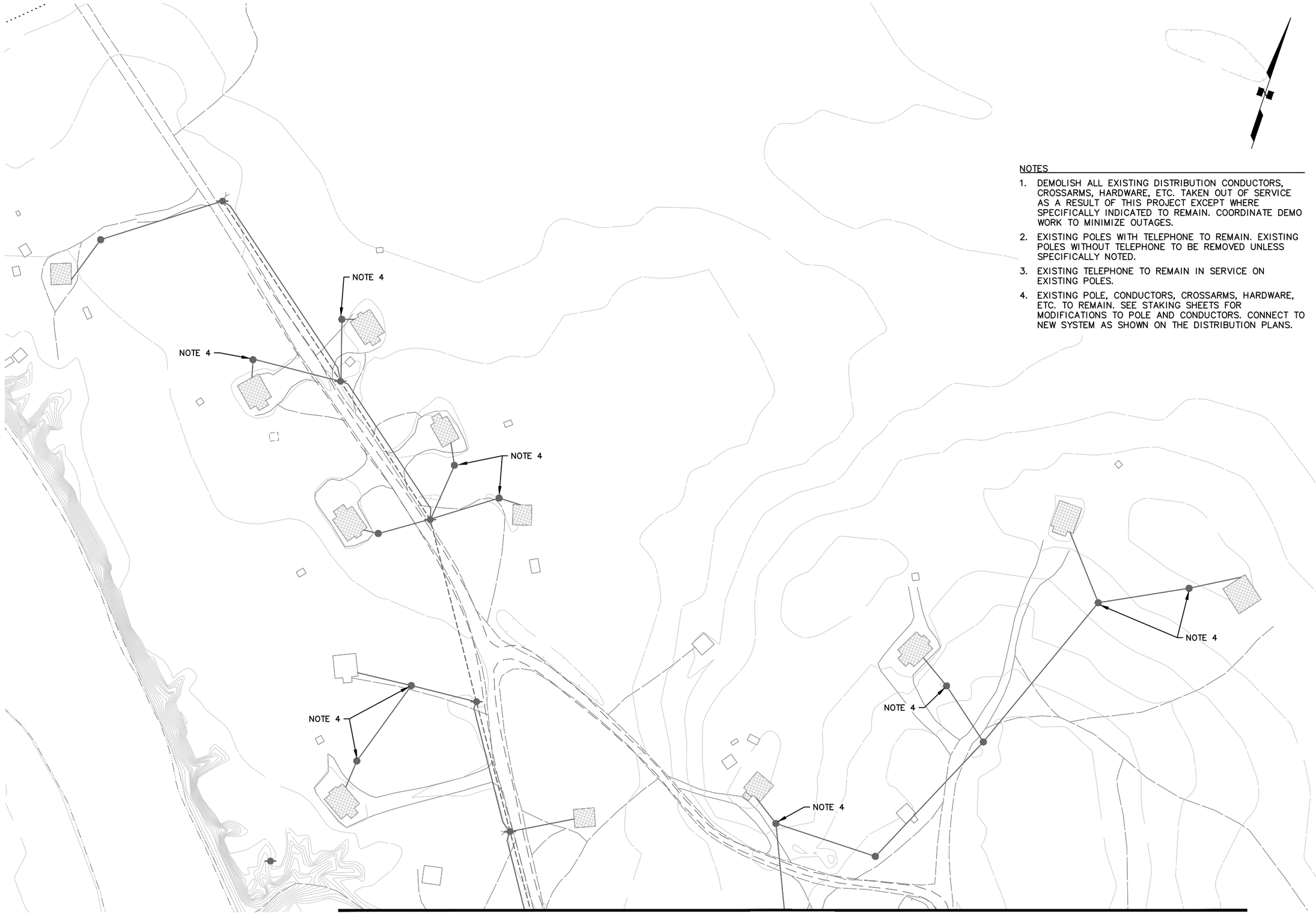

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PROJECT NO. 30416.00 | CITY GRID - | WATER GRID - | SEWER GRID -

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
DEMOLITION PLAN
(3 of 9)

DATE: DEC 2020

PROJECT NO: -

STATUS: 35% DESIGN DRAWINGS

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NOTES

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NOTE 4

NOTE 4

MATCH LINE E2.2

MATCH LINE E2.5

300' 0 300' 600'

CRW ENGINEERING GROUP, LLC
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PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DEMOLITION PLAN
(4 of 9)

DATE: DEC 2020

PROJECT NO: –

STATUS: 35% DESIGN DRAWINGS

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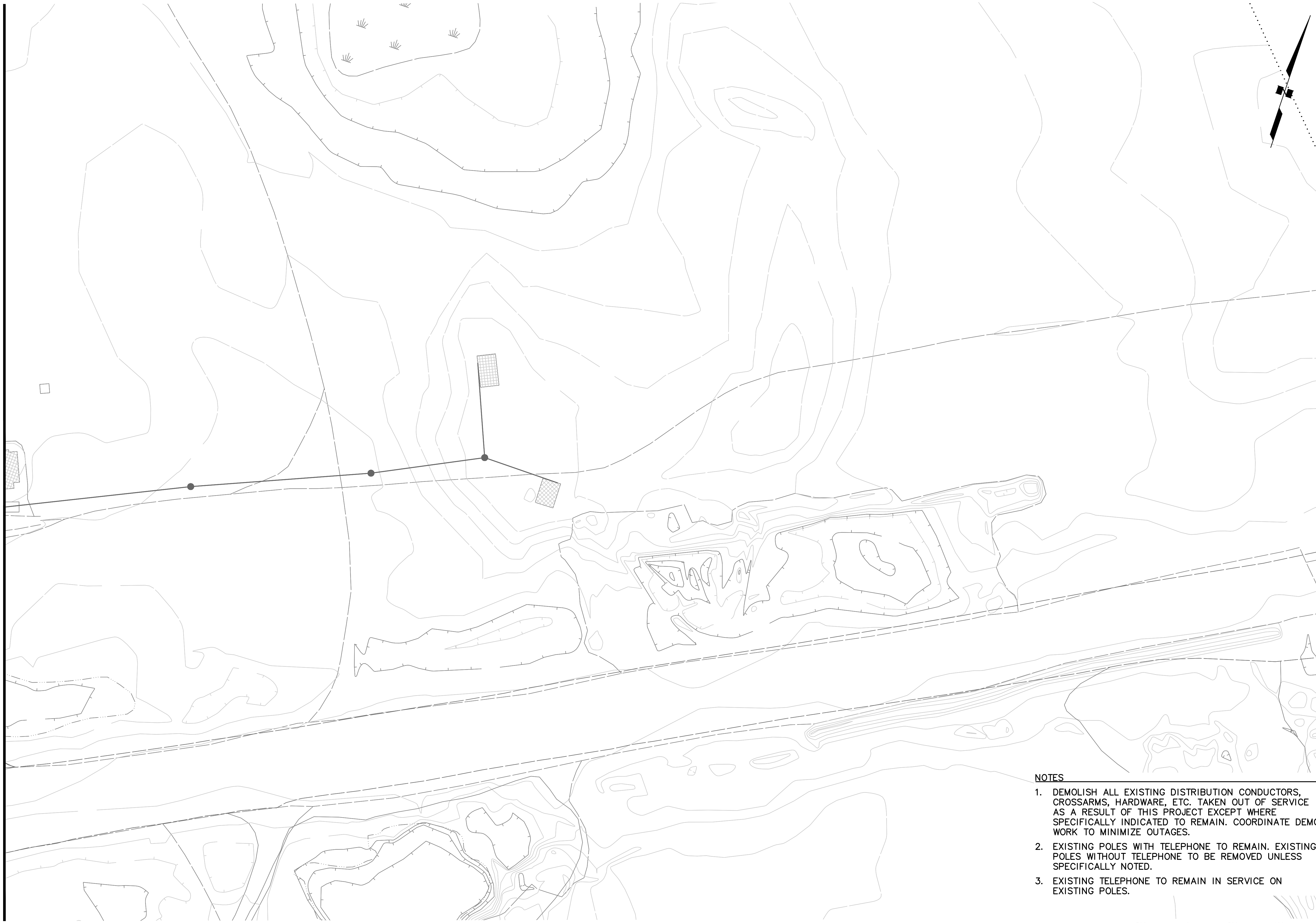

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300' 0 300' 600'

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PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

PROJECT NO: –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DEMOLITION PLAN
(5 of 9)

STATUS: 35% DESIGN DRAWINGS

DATE: DEC 2020

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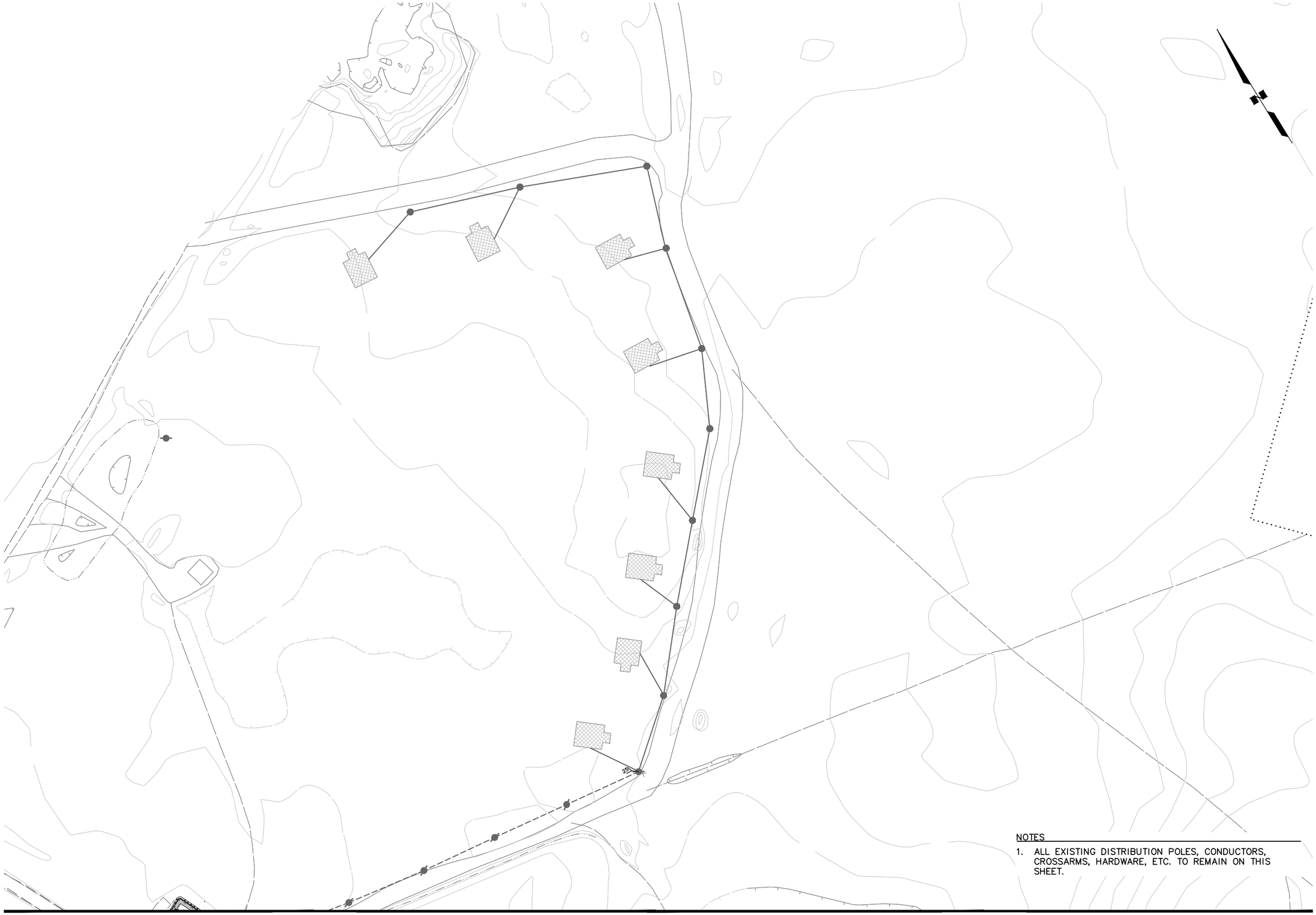

NOTES

1. ALL EXISTING DISTRIBUTION POLES, CONDUCTORS, CROSSARMS, HARDWARE, ETC. TO REMAIN ON THIS SHEET.

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PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DEMOLITION PLAN
(6 of 9)

DATE: DEC 2020

PROJECT NO: –

STATUS: 35% DESIGN DRAWINGS

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MATCH LINE E2.6

MATCH LINE E2.1

MATCH LINE E2.7

NOTE 4

NOTE 4

NOTE 4

NOTE 4

NOTES

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300' 0 300' 600'

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PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DEMOLITION PLAN
(7 of 9)

DATE: DEC 2020

PROJECT NO: –

STATUS: 35% DESIGN DRAWINGS

REV	DATE	DESCRIPTION	REVISION	BY

SCALE HOR. – – VER.
DESIGNED BY –
DRAWN BY –
CHECKED BY –
APPROVED BY –

SHEET NO.

E2.7

File: J:\JobsData\30416.00 Venetie BFU RPSU Project\001 CADD 2019\01 Working Set\03 Electrical\30416.00 Venetie RPSU.dwg PLOT DATE: 12/9/2020 3:59 PM

MATCH LINE E2.7

MATCH LINE E2.9

NOTE 4

NOTE 4

NOTE 4

NOTE 4

NOTE 4

NOTE 4

NOTES

1. DEMOLISH ALL EXISTING DISTRIBUTION CONDUCTORS, CROSSARMS, HARDWARE, ETC. TAKEN OUT OF SERVICE AS A RESULT OF THIS PROJECT EXCEPT WHERE SPECIFICALLY INDICATED TO REMAIN. COORDINATE DEMO WORK TO MINIMIZE OUTAGES.
2. EXISTING POLES WITH TELEPHONE TO REMAIN. EXISTING POLES WITHOUT TELEPHONE TO BE REMOVED UNLESS SPECIFICALLY NOTED.
3. EXISTING TELEPHONE TO REMAIN IN SERVICE ON EXISTING POLES.
4. EXISTING POLE, CONDUCTORS, CROSSARMS, HARDWARE, ETC. TO REMAIN. SEE STAKING SHEETS FOR MODIFICATIONS TO POLE AND CONDUCTORS. CONNECT TO NEW SYSTEM AS SHOWN ON THE DISTRIBUTION PLANS.

300' 0 300' 600'

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 677-3520
#AECC883-24

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA
ENERGY SYSTEM UPGRADE
DEMOLITION PLAN
(8 of 9)

DATE: DEC 2020

STATUS: 35% DESIGN DRAWINGS

PROJECT NO: –

REV	DATE	DESCRIPTION	BY
REVISION			

SCALE HOR. – –
VER.
DESIGNED BY –
DRAWN BY –
CHECKED BY –
APPROVED BY –

SHEET NO.
E2.8

File: J:\JobsData\30416.00 Venetie BFU RPSU Project\001 CADD 2019\01 Working Set\03 Electrical\30416.00 Venetie RPSU.dwg PLOT DATE: 12/9/2020 3:59 PM

MATCH LINE E2.8

NOTES

1. ALL EXISTING DISTRIBUTION POLES, CONDUCTORS, CROSSARMS, HARDWARE, ETC. TO REMAIN ON THIS SHEET.

300' 0 300' 600'

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 677-3520
#AECL883-24

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DEMOLITION PLAN
(9 of 9)

DATE: DEC 2020

STATUS: 35% DESIGN DRAWINGS

PROJECT NO: –

REV	DATE	DESCRIPTION	BY
REVISION			

SCALE HOR. – VER. –
DESIGNED BY –
DRAWN BY –
CHECKED BY –
APPROVED BY –

SHEET NO.

E2.9

File: J:\JobsData\30416.00 Venetie BFU RPSU Project\001 CADD 2019\01 Working Set\03 Electrical\30416.00 Venetie RPSU.dwg PLOT DATE: 12/9/2020 3:59 PM

NOTES

1. INSTALL NEW POLE PRIOR TO STARTING WORK ON NEW POWER PLANT SITE. TEMPORARILY CONNECT NEW POLE TO EXISTING STEP-UP TRANSFORMER AND EXISTING POLE TO THE NORTHEAST.

MATCH LINE E3.2

NOTE 1

MATCH LINE E3.7

300' 0 300' 600'

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 677-3520
#AECL883-24

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DISTRIBUTION PLAN
(1 of 9)

DATE: DEC 2020

STATUS: 35% DESIGN DRAWINGS

PROJECT NO: –

REV	DATE	DESCRIPTION	BY
REVISION			

SCALE
HOR. –
VER. –

DESIGNED BY –
DRAWN BY –
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SHEET NO.

E3.1

File: J:\JobsData\30416.00 Venetie BFU RPSU Project\001 CADD 2019\01 Working Set\03 Electrical\30416.00 Venetie RPSU.dwg PLOT DATE: 12/9/2020 3:59 PM

MATCH LINE E3.3

MATCH LINE E3.4

MATCH LINE E3.1

60' 0 60' 120'

E3.2

SHEET NO.

SCALE
HOR. –
VER. –

DESIGNED BY –

DRAWN BY –

CHECKED BY –

APPROVED BY –

REVISION			
REV	DATE	DESCRIPTION	BY

PROJECT NO: –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DISTRIBUTION PLAN
(2 of 9)

STATUS: 35% DESIGN DRAWINGS DATE: DEC 2020

PROJECT NO.
30416.00

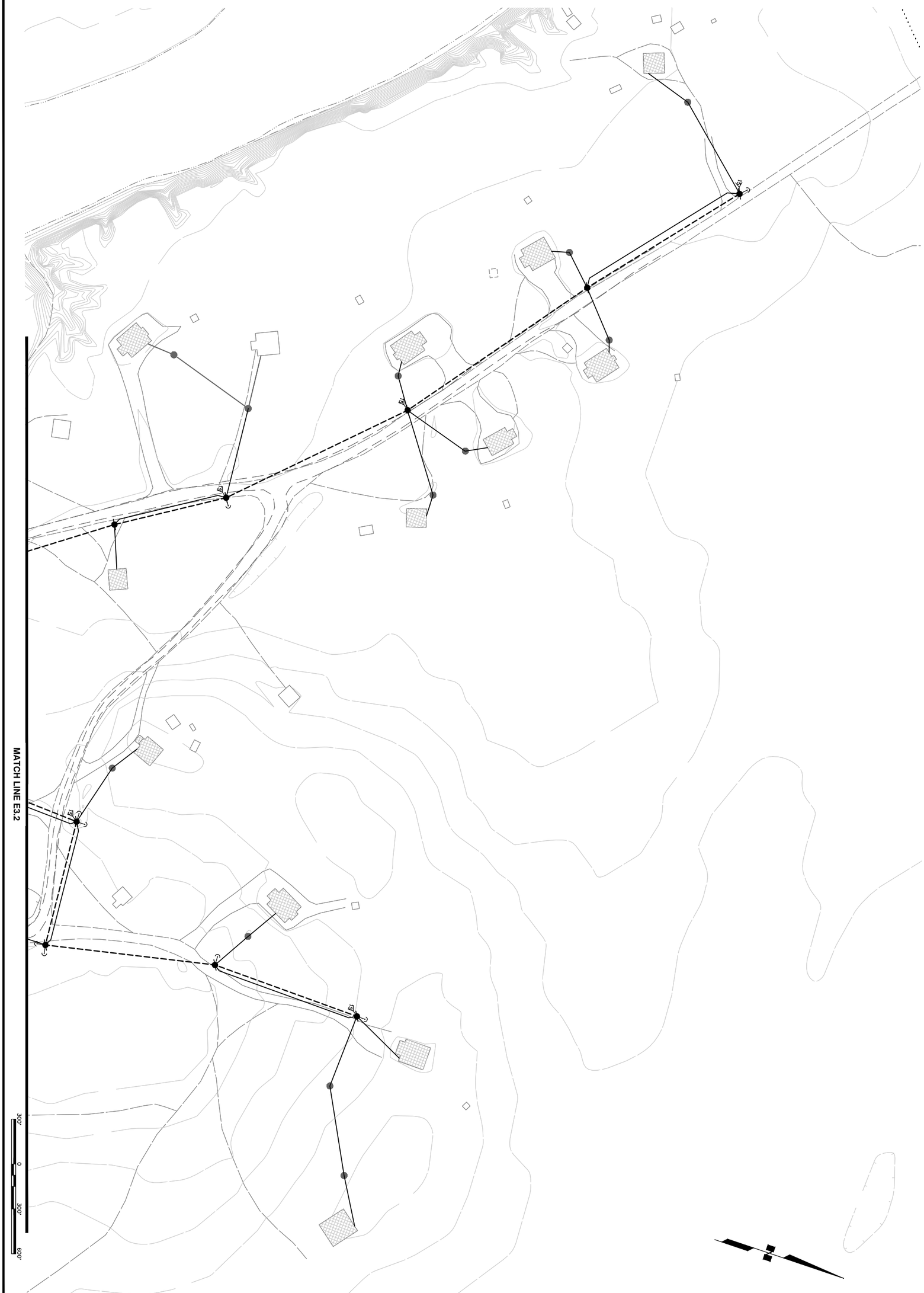
CITY GRID
–

WATER GRID
–

SEWER GRID
–

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

File: J:\JobsData\30416.00 Venetie BFU RPSU Project\001 CADD 2019\01 Working Set\03 Electrical\30416.00 Venetie RPSU.dwg PLOT DATE: 12/9/2020 3:59 PM



SHEET NO.
E3.3

SCALE
HOR. –
VER. –

DESIGNED BY –

DRAWN BY –

CHECKED BY –

APPROVED BY –

REVISION			
REV	DATE	DESCRIPTION	BY

PROJECT NO: –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DISTRIBUTION PLAN
(3 of 9)

STATUS: 35% DESIGN DRAWINGS DATE: DEC 2020

PROJECT NO.
30416.00

CITY GRID
–

WATER GRID
–

SEWER GRID
–

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

MATCH LINE E3.2

MATCH LINE E3.5

E3.4
SHEET NO.

SCALE	
HOR.	–
VER.	–
DESIGNED BY	–
DRAWN BY	–
CHECKED BY	–
APPROVED BY	–

REVISION			
REV	DATE	DESCRIPTION	BY

PROJECT NO: –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

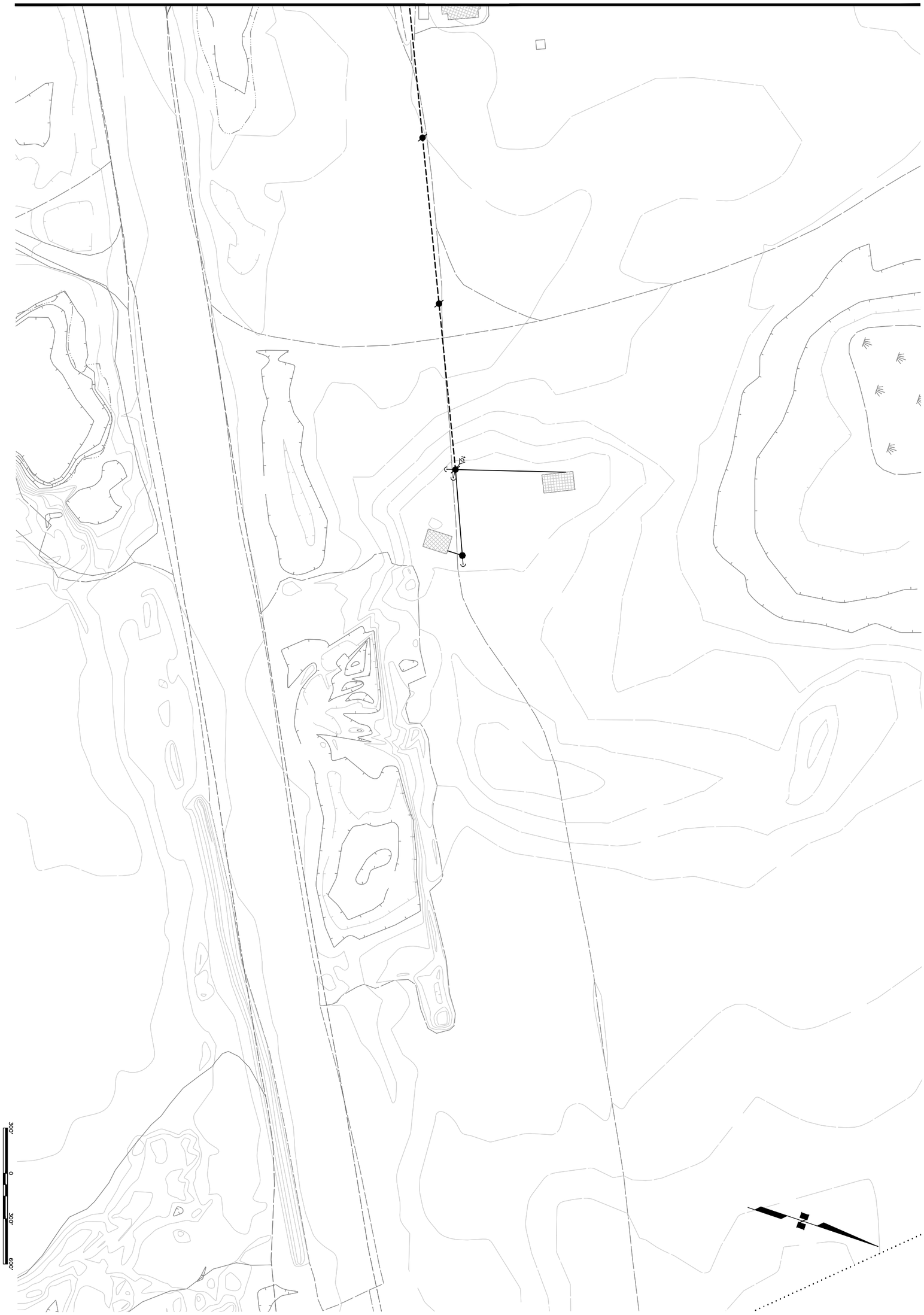
DISTRIBUTION PLAN
(4 of 9)

STATUS: 35% DESIGN DRAWINGS DATE: DEC 2020

PROJECT NO.	30416.00
CITY GRID	–
WATER GRID	–
SEWER GRID	–

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

MATCH LINE E3.4



300' 0 300' 600'

E3.5 SHEET NO.	SCALE HOR. – VER. –	REVISION REV / DATE / DESCRIPTION / BY	PROJECT NO: –	PROJECT NO. 30416.00	CRW ENGINEERING GROUP, LLC
	DESIGNED BY –		VENETIE, ALASKA	CITY GRID –	3940 ARCTIC BLVD. SUITE 300 ANCHORAGE, ALASKA 99503 PHONE: (907) 562-3252 #AECL882-AK
	DRAWN BY –		ENERGY SYSTEM UPGRADE	WATER GRID –	
	CHECKED BY –		DISTRIBUTION PLAN (5 of 9)	SEWER GRID –	
	APPROVED BY –		STATUS: 35% DESIGN DRAWINGS DATE: DEC 2020		

File: J:\JobsData\30416.00 Venetie BFU RPSU Project\001 CADD 2019\01 Working Set\03 Electrical\30416.00 Venetie RPSU.dwg PLOT DATE: 12/9/2020 4:00 PM

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 677-3520
#AECL883-24

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DISTRIBUTION PLAN
(6 of 9)

PROJECT NO: –

STATUS: 35% DESIGN DRAWINGS

DATE: DEC 2020

REV	DATE	DESCRIPTION	BY
REVISION			

SCALE
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VER. –

DESIGNED BY –
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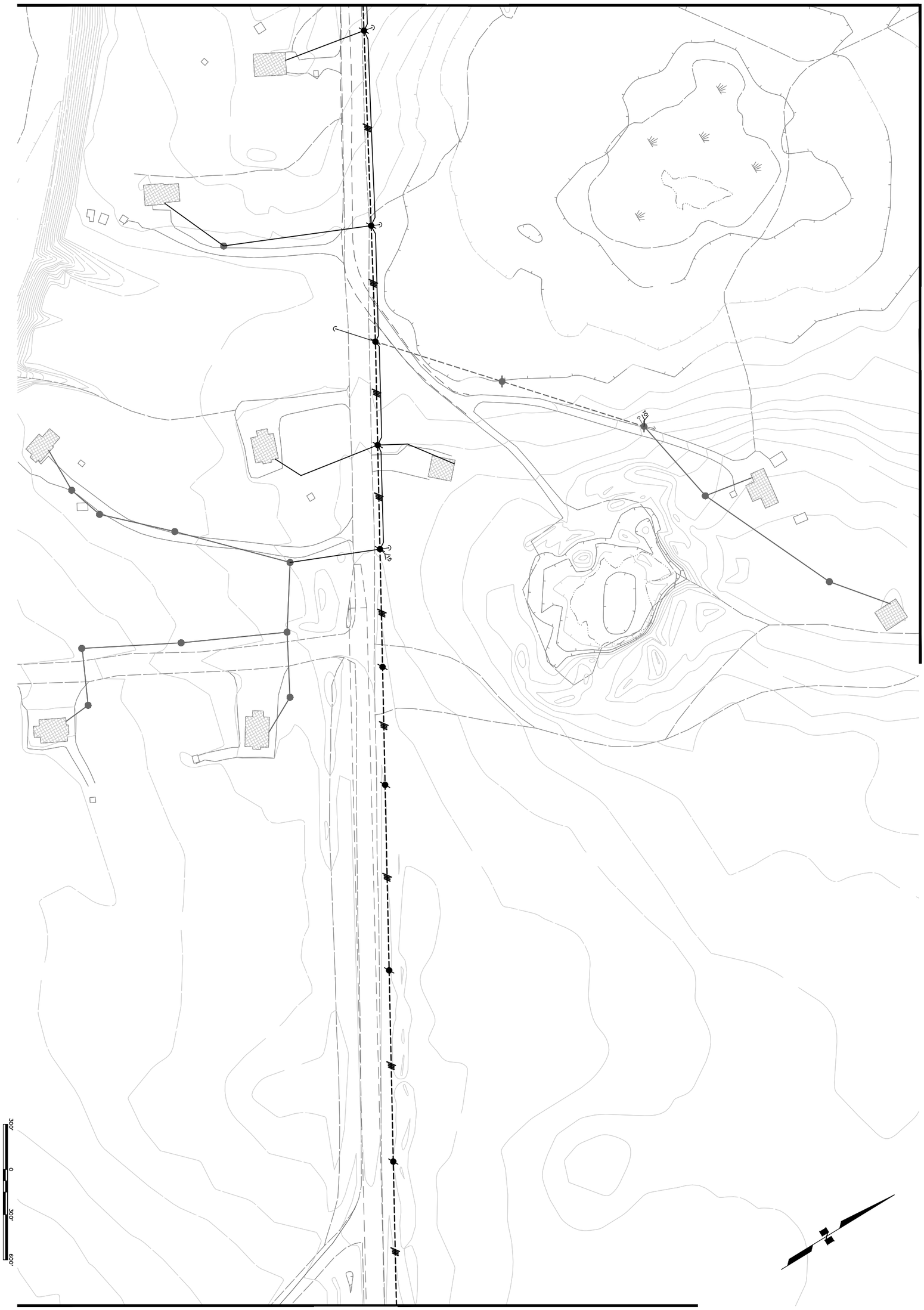
APPROVED BY –

SHEET NO.

E3.6

MATCH LINE E3.1



MATCH LINE E3.6

MATCH LINE E3.7

300' 0 300' 600'

SHEET NO. **E3.7**

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HOR. –
VER. –

DESIGNED BY –
DRAWN BY –
CHECKED BY –
APPROVED BY –

REVISION			
REV	DATE	DESCRIPTION	BY

PROJECT NO: –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DISTRIBUTION PLAN
(7 of 9)

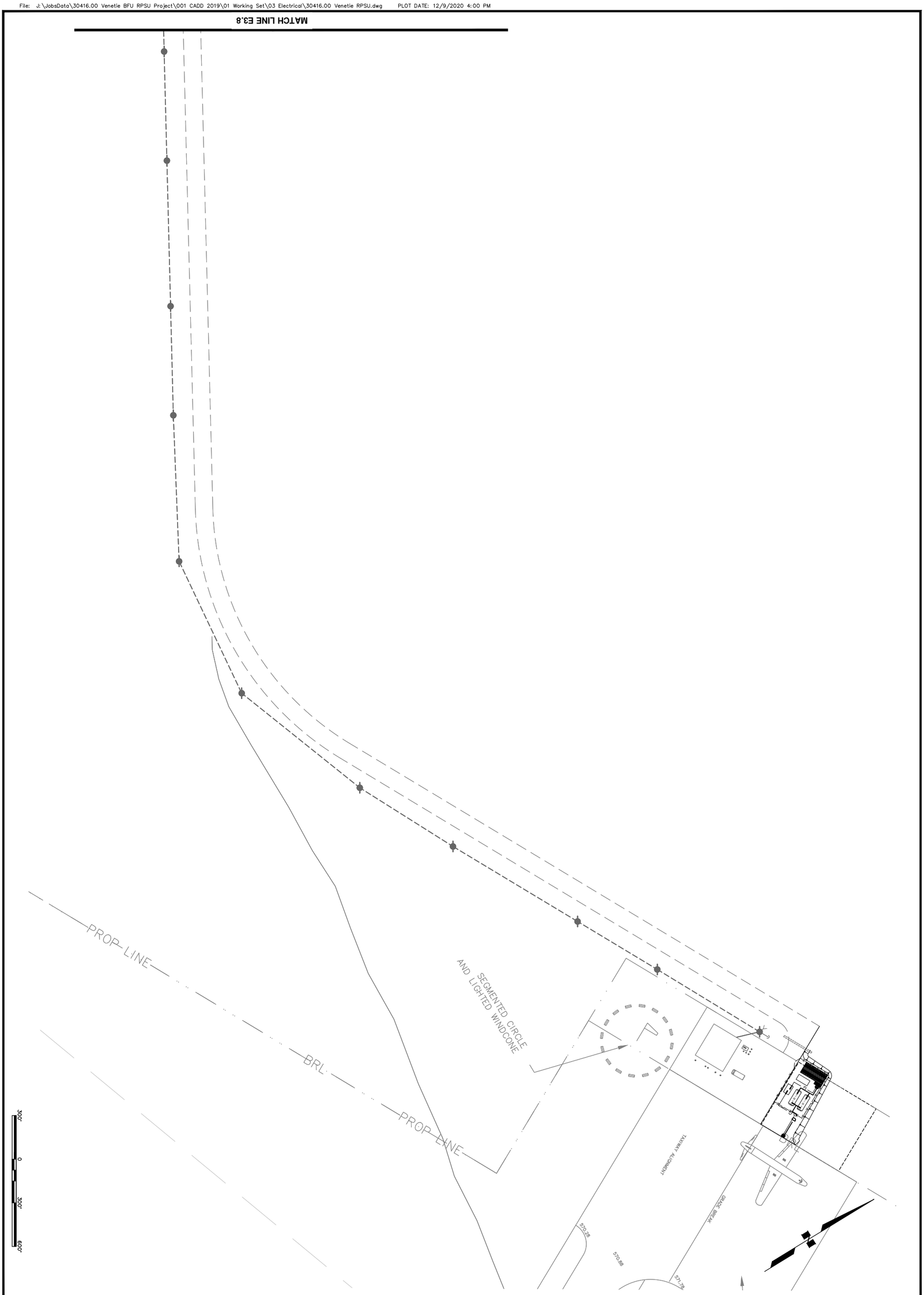
STATUS: 35% DESIGN DRAWINGS DATE: DEC 2020

PROJECT NO. 30416.00
CITY GRID –
WATER GRID –
SEWER GRID –

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

E3.8 SHEET NO.	SCALE HOR. – VER. –	REVISION REV / DATE / DESCRIPTION / BY	PROJECT NO: –	–	PROJECT NO. 30416.00
	DESIGNED BY –		VENETIE, ALASKA		CITY GRID –
	DRAWN BY –		ENERGY SYSTEM UPGRADE		WATER GRID –
	CHECKED BY –		DISTRIBUTION PLAN (8 of 9)		SEWER GRID –
	APPROVED BY –		STATUS: 35% DESIGN DRAWINGS	DATE: DEC 2020	

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK



E3.9
SHEET NO.

SCALE	
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CHECKED BY	–
APPROVED BY	–

REVISION			
REV	DATE	DESCRIPTION	BY

PROJECT NO: –

VENETIE, ALASKA

ENERGY SYSTEM UPGRADE

DISTRIBUTION PLAN
(9 of 9)

STATUS: 35% DESIGN DRAWINGS DATE: DEC 2020

PROJECT NO.	30416.00
CITY GRID	–
WATER GRID	–
SEWER GRID	–

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

Appendix B

Cost Estimates

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR/ EQUIP	TOTAL COST
Clear & Prep Site	1	lump		$0	80	80	$125	$10,000	$0	$10,000
Excavatation	250	cu.yd.	$0	$0	0.50	125	$125	$15,625	$0	$15,625
Type 2 Classified Fill	250	cu.yd.	$20	$5,000	0.75	188	$125	$23,438	$0	$28,438
Rigid Insulation for Footings, 4"	1,280	sq. ft..	$4	$5,120	0.05	64	$125	$8,000	$0	$13,120
Fuel Resistant Membrane Liner	1,600	sq. ft..	$2	$3,200	0.01	16	$125	$2,000	$0	$5,200
Non-woven Geotextile Fabric	3,200	sq. ft..	$0.15	$480	0.01	16	$125	$2,000	$0	$2,480
Form Lumber, Rebar, Etc	1	lump	$2,000	$2,000	0.00	0	$125	$0	$0	$2,000
Form & Pour Concrete Footings	10	cu.yd.	$100	$1,000	8	80	$125	$10,000	$0	$11,000
Place Main Beams on Footings & Anchor	1	lump	$10,000	$10,000	40	40	$125	$5,000	$0	$15,000
Install Pre-Fab Steel Floor Panels	1	lump	$90,000	$90,000	120	120	$125	$15,000	$0	$105,000
Bolts, Anchors, Nails, Etc.	1	lump	$1,000	$1,000	20	20	$125	$2,500	$0	$3,500
Wall Framing. Plywood, Insul, Etc.	1	lump	$8,000	$8,000	150	150	$125	$18,750	$0	$26,750
Roof Trusses, Plywood, Insul, Etc.	1	lump	$8,000	$8,000	120	120	$125	$15,000	$0	$23,000
Doors & Windows	1	lump	$16,000	$16,000	100	100	$125	$12,500	$0	$28,500
Paint Floor & Doors	1	lump	$1,200	$1,200	60	60	$125	$7,500	$0	$8,700
Metal Roofing, Ice Shield, Etc	1,100	sq.ft.	$8	$8,800	0.08	88	$125	$11,000	$0	$19,800
Metal Exterior Siding	1,800	sq.ft.	$5	$9,000	0.08	144	$125	$18,000	$0	$27,000
Metal Interior Wainscot	2,300	sq.ft.	$4.50	$10,350	0.05	115	$125	$14,375	$0	$24,725
Stairs & Landings	1	lump	$2,500	$2,500	80	80	$125	$10,000	$0	$12,500
Chain Link Fencing	120	ft.	$40	$4,800	0.70	84	$125	$10,500	$0	$15,300
Sub-Total Site Prep & Building				**$186,450**		**1,690**		**$211,188**	**$0**	**$397,638**
Grounding Grid	1	lump	$5,000	$5,000	40	40	$125	$5,000	$0	$10,000
225kVA Step Up Transformer	1	ea.	$18,000	$18,000	80	80	$125	$10,000	$0	$28,000
480V Feeder Module to Transformer	1	lump	$1,000	$1,000	20	20	$125	$2,500	$0	$3,500
New Feeder to Existing Distribution	1	lump	$10,000	$10,000	100	100	$125	$12,500	$0	$22,500
8,000 Gallon Intermediate Tank	1	lump	$40,000	$40,000	20	20	$125	$2,500	$0	$42,500
Place Inter. Tank on Footings & Anchor	1	lump	$1,000	$1,000	20	20	$125	$2,500	$0	$3,500
Fuel Tank Piping & Appurtenances	1	lump	$10,000	$10,000	100	100	$125	$12,500	$0	$22,500
Arctic Pipe 2" Steel (Phase 1 Heat Recov)	400	ft.	$40	$16,000	0.60	240	$125	$30,000	$0	$46,000
Modify HR Piping at Washeteria (Ph 1 HR)	1	lump	$2,000	$2,000	40	40	$125	$5,000	$0	$7,000
Backfeed Panel at Washeteria (Ph 1 HR)	1	ea.	$3,000	$3,000	30	30	$125	$3,750	$0	$6,750
Sub Total Exterior Site Mechanical & Electrical				**$106,000**		**690**		**$86,250**	**$0**	**$192,250**
100 kW Genset (JD 4045AFM85)	1	ea.	$65,000	$65,000	70	70	$125	$8,750	$0	$73,750
150 kW Genset (JD 6068TFM85)	1	ea.	$75,000	$75,000	70	70	$125	$8,750	$0	$83,750
210 kW Genset (JD 6091TFM85)	1	ea.	$95,000	$95,000	70	70	$125	$8,750	$0	$103,750
Mufflers & Crank Vent Pipe, Fittings, Etc.	3	ea.	$4,000	$12,000	30	90	$125	$11,250	$0	$23,250

Switchgear & Control Panels	1	lump	$240,000	$240,000	200	200	$125	$25,000	$0	$265,000
Fire Supression	1	lump	$3,000	$3,000	80	80	$125	$10,000	$35,000	$48,000
Sheet Metal Fabrications	1	lump	$20,000	$20,000	80	80	$125	$10,000	$0	$30,000
Hydronic Piping, Equip, & HX	1	lump	$25,000	$25,000	180	180	$125	$22,500	$0	$47,500
Radiators	2	ea.	$12,000	$24,000	40	80	$125	$10,000	$0	$34,000
Day Tank, Hopper & Blender	1	ea.	$16,000	$16,000	60	60	$125	$7,500	$0	$23,500
Fuel & Oil Pumps & Appurt.	1	lump	$22,000	$22,000	80	80	$125	$10,000	$0	$32,000
Fuel & Oil Pipe, Fittings, Valves	1	lump	$12,000	$12,000	160	160	$125	$20,000	$0	$32,000
Hoses & Fittings	1	lump	$3,500	$3,500	30	30	$125	$3,750	$0	$7,250
Pipe Insulation	1	lump	$4,500	$4,500	40	40	$125	$5,000	$0	$9,500
Conduit, Cable & Elec Equipment	1	lump	$30,000	$30,000	260	260	$125	$32,500	$0	$62,500
Feeder & Shielded Cable	1	lump	$12,000	$12,000	100	100	$125	$12,500	$0	$24,500
Misc Strut, Hangers, Fasteners, Etc.	1	lump	$5,000	$5,000	60	60	$125	$7,500	$0	$12,500
Fill Coolant, Fuel, & Lube	1	lump	$5,000	$5,000	20	20	$125	$2,500	$0	$7,500
Sub Total Interior Mechanical & Electrical				**$669,000**		**1,730**		**$216,250**	**$35,000**	**$920,250**
Air Mobilization Fairbanks to Venetie	107,790	lbs	$1.00			120	$100	$12,000	$107,790	$119,790
Misc.Small Freight	1	lump	$10,000						$10,000	$10,000
Repair/Rent Local Heavy Equip	1	lump	$10,000	$10,000		200	$125	$25,000	$10,000	$45,000
Rent Pickup Truck	3	month							$3,000	$3,000
Project Diesel Fuel/Gasoline/Consumables	1	lump							$10,000	$10,000
Test/Commission/Train Operators	140	hr			1	140	$125	$17,500		$17,500
Superintendent Overhead	1	lump			1	80	$125	$10,000		$10,000
Crew Travel Time	1	lump			1	100	$125	$12,500		$12,500
Crew Airfares	10	trips	$1,000						$10,000	$10,000
Crew Per Diem	475	mn.dy							$28,497	$28,497
Room Rent	475	mn.dy							$47,495	$47,495
Job Mob & Demob	1	lump	$25,000						$25,000	$25,000
O&M and Office Supplies	1	lump	$3,000						$3,000	$3,000
Power Plant Upgrade Project Construction Sub-Total				**$971,450**		**4,750**		**$590,688**	**$289,782**	**$1,851,920**
Contractor Bond Overhead & Profit	20%	%								$370,384
Project Contigency	15%	%								$277,788
									Power Plant On Site Total Estimated Construction Cost	**$2,500,091**

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR/ EQUIP	TOTAL COST
Arctic Pipe 2-1/2" Steel	200	ft.	$50	$10,000	0.60	120	$125	$15,000	$0	$25,000
Piping, Pump, Instrumentation, Etc.	1	lump	$8,000	$8,000	60	60	$125	$7,500	$0	$15,500
Backfeed Panel	1	ea.	$3,000	$3,000	30	30	$125	$3,750	$0	$6,750
Conduit, Conductors, Devices, Etc.	1	lump	$5,000	$5,000	40	40	$125	$5,000	$0	$10,000
Rent Heavy Equip.	1	lump							$1,000	$1,000
Project Diesel Fuel/Gasoline/Consumables	1	lump							$250	$250
Superintendent Overhead	20	hr			1	20	$125	$2,500		$2,500
Crew Travel Time	20	hr			1	20	$125	$2,500		$2,500
Crew Airfares	2	trips							$2,000	$2,000
Crew Per Diem	25	mn.dy							$1,500	$1,500
Room Rent	25	mn.dy							$2,500	$2,500
Miscellaneous Small Freight	1	lump	$500						$500	$500
Add. Alternate #1 - Sanitation Facility Heat Recovery Sub-Total				**$26,000**		**290**		**$36,250**	**$7,750**	**$70,000**
Contractor Bond Overhead & Profit	20%	%								$14,000
Project Contigency	15%	%								$10,500
Phase 2 Heat Recovery to Sanitation Facility Total Estimated Construction Cost										**$94,500**
Arctic Pipe 2" Steel	400	ft.	$40	$16,000	0.60	240	$125	$30,000	$0	$46,000
Piping, Heating Equip, Instrument, Etc.	1	lump	$10,000	$10,000	80	80	$125	$10,000	$0	$20,000
BTU Meter	1	ea.	$9,000	$9,000	30	30	$125	$3,750	$0	$12,750
Backfeed Panel	1	ea.	$3,000	$3,000	30	30	$125	$3,750	$0	$6,750
Conduit, Conductors, Devices, Etc.	1	lump	$7,000	$7,000	40	40	$125	$5,000	$0	$12,000
Rent Heavy Equip.	1	lump							$500	$500
Project Diesel Fuel/Gasoline/Consumables	1	lump							$100	$100
Superintendent Overhead	5	hr			1	5	$125	$625		$625
Crew Travel Time	10	hr			1	10	$125	$1,250		$1,250
Crew Airfares	1	trips							$1,000	$1,000
Crew Per Diem	42	mn.dy							$2,520	$2,520
Room Rent	42	mn.dy							$4,200	$4,200
Miscellaneous Small Freight	1	lump	$500						$500	$500
Additive Alternate #2 - BIA Facility Heat Recovery Sub-Total				**$45,000**		**435**		**$54,375**	**$8,820**	**$108,195**
Contractor Bond Overhead & Profit	20%	%								$21,639
Project Contigency	15%	%								$16,229
Phase 3 Heat Recovery to BIA Facility Total Estimated Construction Cost										**$146,063**

ITEM	QUANT	UNIT	UNIT COST	MATL COST	UNIT HRS	LABOR HRS	LABOR RATE	LABOR COST	CONTR COST	TOTAL COST
SITE WORK										
Clear and Prep Site	1	lump		$0		120	$125	$15,000		$15,000
Excavation	600	cu. yd.	$0.00	$0	0.500	300	$125	$37,500		$37,500
Non-Woven Geotextile	6,000	sq. ft.	$0.15	$900	0.010	60	$125	$7,500		$8,400
Type 2 Classified Fill (Locally Avail)	1,200	cu.yd.	$5	$6,000	0.50	600	$125	$75,000		$81,000
6' Chain-Link Fence	220	lf	$40.00	$8,800	0.700	154	$125	$19,250		$28,050
Stairs and Landings	1	lump	$5,000.00	$5,000			$125			$5,000
TANK INSTALLATION										
8,000 Gallon Double Wall AST	2	ea	$24,000	$48,000	0.000	0	$125	$0		$48,000
5,000 Gallon Double Wall AST	1	ea	$40,000	$40,000	0.000	0	$125	$0		$40,000
Emergency Vents	6	ea	$500	$3,000	3.00	18	$125	$2,250		$5,250
Pressure/Vacuum/Whistle Vents	3	ea	$300	$900	3.00	9	$125	$1,125		$2,025
Clock Type Gauges	3	ea	$300	$900	3.00	9	$125	$1,125		$2,025
Form Lumber, Rebar, Etc	1	lump	$2,000	$2,000	0.00	0	$125	$0		$2,000
Concrete Tank Foundations	25	cu.yd.	$100	$2,500	8	200	$125	$25,000		$27,500
Set and level Tanks	3	ea		$0	20.00	60	$125	$7,500		$7,500
Retail Dispensing System										
5,000 Dual Protected Dispensing Tank and Appurtenances	1	ea	$65,000	$65,000	0.000	0	$125	$0		$65,000
Retail Dispenser Enclosure	1	ea	$25,000	$25,000	0.000	0	$125	$0		$25,000
Dual Product Retail Dispenser	1	ea	$25,000	$25,000	60.00	0	$125	$0		$25,000
Set and level Tank System	1	ea		$0	20.00	20	$125	$2,500		$2,500
PUMP / PIPING SYSTEM										$0
3" Sch 80 Welded Above Grade	100	lin. ft.	$13.00	$1,300	0.25	25	$125	$3,125		$4,425
2" Sch 80 Welded Above Grade	100	lin. ft.	$11.00	$1,100	0.25	25	$125	$3,125		$4,225
Misc Strut & Pipe Clamps	1	lump	$500	$500	0.25	0	$125	$31		$531
Flexible Connectors	8	ea	$150	$1,200	1.50	12	$125	$1,500		$2,700
Bulk Transfer Pump / Meter Enclosure	1	lump	$20,000	$20,000	60	60	$125	$7,500		$27,500
Hose Reel	2	ea	$2,500	$5,000	16	32	$126	$4,032		$9,032
3" Flanged Check Valves	4	ea	$300	$1,200	2.00	8	$125	$1,000		$2,200
2" Flanged Check Valves	4	ea	$300	$1,200	2.00	8	$125	$1,000		$2,200
3" Flanged Ball Valves	4	ea	$250	$1,000	1.50	6	$125	$750		$1,750
2" Flanged Ball Valves	7	ea	$250	$1,750	1.50	11	$125	$1,313		$3,063
1.5" Flanged Ball Valves	2	ea	$250	$500	1.50	3	$125	$375		$875
2" Flanged Strainers	2	ea	$250	$500	1.50	3	$125	$375		$875
3" Flanged Strainers	2	ea	$250	$500	1.50	3	$125	$375		$875
2" Anti Siphon Valves	3	ea	$200	$600	1.00	3	$125	$375		$975
Quick Couplers	2	ea	$300	$600	2.00	4	$125	$500		$1,100

Meter	2	ea	$300	$600	3.00	6	$125	$750		$1,350
Pressure Test Point	4	ea	$300	$1,200	4.00	16	$125	$2,000		$3,200
Misc Valves	1	lump	$1,500	$1,500	20.00	20	$125	$2,500		$4,000
1" Flanged PRV	6	ea	$650	$3,900	2.00	12	$125	$1,500		$5,400
Submersible Pumps	3	ea	$1,500	$4,500	6.00	18	$125	$2,250		$6,750
Timber Pipe Supports and Hardware	1	lump	$5,000	$5,000	40.00	40	$125	$5,000		$10,000
Signs & Valve Tags	1	lump	$2,500	$2,500	16.00	16	$125	$2,000		$4,500
Filters	2	ea	$1,200	$2,400	4.00	8	$125	$1,000		$3,400
POWER, CONTROLS, ETC.										$0
Control Panels	2	ea	$20,000	$40,000	40.00	80	$125	$10,000		$50,000
Area Lighting	5	ea	$3,000	$15,000	40.00	200	$125	$25,000		$40,000
Conduit, Conductors, & Devices	1	lump	$15,000	$15,000	120.00	120	$125	$15,000		$30,000
3-Point High/Low Level Switches	9	ea	$1,000	$9,000	5.00	45	$125	$5,625		$14,625
MISCELLANEOUS										
Steel Truck Fill Secondary Containment	1	ea	$50,000	$50,000	150	150	$125	$18,750		$68,750
Superintendent Overhead	1	lump				100	$125	$12,500		$12,500
Welding Rod, Gases, Etc.	1	lump	$15,000	$15,000	0.00	0	$125	$0		$15,000
Project Diesel Fuel/Gasoline	1	lump							$5,000	$5,000
Surveying	1	lump							$15,000	$15,000
Repair/Rent Local Heavy Equip	1	lump	$10,000	$10,000		200	$125	$25,000	$10,000	$45,000
Welder/Compr/Misc Tool Rent	1	lump							$10,000	$10,000
Misc Hardware	1	lump	$5,000	$5,000	0.00	0	$125	$0		$5,000
Misc Tools & Safety Gear	1	lump	$10,000	$10,000	0.00	0	$125	$0		$10,000
Spill Response Supplies	1	lump	$15,000	$15,000	16.00	16	$125	$2,000		$17,000
Connex Storage Van	1	lump	$10,000	$10,000	40.00	40	$125	$5,000		$15,000
Commission System & Training	1	lump				60	$125	$7,500		$7,500
Crew Travel Time	1	lump				80	$125	$10,000		$10,000
Crew Airfares	8	R.Trps	$1,500						$12,000	$12,000
Crew Per Diem	430	mn.dy	$60						$25,800	$25,800
Lodging (Commercial)	4	mo.	$3,500						$14,000	$14,000
FREIGHT										
Air Freight Fairbanks to Venetie	143250	lb.	$1.00						$143,250	$143,250
Truck Freight to Fbks	143250	lb.	$0.10						$14,325	$14,325
TANK FARM SUB TOTAL (RAW COST)				$485,550		2,980		$372,501	$249,375	**$1,107,426**
Contractor Bond Overhead & Profit	20%	%								$221,485
Project Contigency	15%	%								$166,114
										$1,495,025

Village Tank Farm and Dispensing Total Estimated Construction Cost

ITEM	QUANT	UNIT	UNIT COST	MATL COST	UNIT HRS	LABOR HRS	LABOR RATE	LABOR COST	CONTR COST	TOTAL COST
SITE WORK										
Clear and Prep Site	1	lump		$0		40	$125	$5,000		$5,000
Excavation	200	cu. yd.	$0.00	$0	0.500	100	$125	$12,500		$12,500
Non-Woven Geotextile	1,600	sq. ft.	$0.15	$240	0.010	16	$125	$2,000		$2,240
Type 2 Classified Fill (Locally Avail)	300	cu.yd.	$5	$1,500	0.50	150	$125	$18,750		$20,250
6' Chain-Link Fence	110	lf	$40.00	$4,400	0.700	77	$125	$9,625		$14,025
Stairs and Landings	1	lump	$5,000.00	$5,000			$125			$5,000
TANK INSTALLATION										
8,000 Gallon Double Wall AST	2	ea	$24,000	$48,000	0.000	0	$125	$0		$48,000
Emergency Vents	4	ea	$500	$2,000	3.00	12	$125	$1,500		$3,500
Pressure/Vacuum/Whistle Vents	2	ea	$300	$600	3.00	6	$125	$750		$1,350
Clock Type Gauges	2	ea	$300	$600	3.00	6	$125	$750		$1,350
2" Fill Limiter	2	ea	$800	$1,600	4.00	8	$125	$1,000		$2,600
Form Lumber, Rebar, Etc	1	lump	$1,000	$1,000	0.00	0	$125	$0		$1,000
Concrete Tank Foundations	15	cu.yd.	$100	$1,500	8	120	$125	$15,000		$16,500
Set and level Tanks	2	ea		$0	20.00	40	$125	$5,000		$5,000
PUMP / PIPING SYSTEM										$0
2" Sch 80 Welded Below Grade	100	lin. ft.	$15.00	$1,500	0.50	50	$125	$6,250		$7,750
3" Sch 80 Welded Above Grade	50	lin. ft.	$13.00	$650	0.25	13	$125	$1,563		$2,213
Misc Strut & Pipe Clamps	1	lump	$500	$500	0.25	0	$125	$31		$531
Flexible Connectors	4	ea	$150	$600	1.50	6	$125	$750		$1,350
2" Flanged Ball Valves	2	ea	$250	$500	1.50	3	$125	$375		$875
2" Flanged Check Valves	1	ea	$300	$300	2.00	2	$125	$250		$550
3" Flanged Ball Valves	3	ea	$250	$750	1.50	5	$125	$563		$1,313
3" Flanged Check Valves	1	ea	$300	$300	2.00	2	$125	$250		$550
Misc Valves	1	lump	$500	$500	20.00	20	$125	$2,500		$3,000
1" Flanged PRV	2	ea	$650	$1,300	2.00	4	$125	$500		$1,800
Signs & Valve Tags	1	lump	$2,500	$2,500	16.00	16	$125	$2,000		$4,500
POWER, CONTROLS, ETC.										$0
Control Panels	1	ea	$10,000	$10,000	40.00	40	$125	$5,000		$15,000
Area Lighting	1	ea	$3,000	$3,000	40.00	40	$125	$5,000		$8,000
Conduit, Conductors, & Devices	1	lump	$15,000	$15,000	120.00	120	$125	$15,000		$30,000
MISCELLANEOUS										
Superintendent Overhead	1	lump				40	$125	$5,000		$5,000
Welding Rod, Gases, Etc.	1	lump	$5,000	$5,000	0.00	0	$125	$0		$5,000
Project Diesel Fuel/Gasoline	1	lump							$2,500	$2,500
Surveying	1	lump							$7,500	$7,500
Repair/Rent Local Heavy Equip	1	lump	$5,000	$5,000		40	$125	$5,000	$10,000	$20,000

Welder/Compr/Misc Tool Rent	1	lump							$5,000	$5,000
Misc Hardware	1	lump	$2,500	$2,500	0.00	0	$125	$0		$2,500
Misc Tools & Safety Gear	1	lump	$5,000	$5,000	0.00	0	$125	$0		$5,000
Commission System & Training	1	lump				24	$125	$3,000		$3,000
Crew Travel Time	1	lump				40	$125	$5,000		$5,000
Crew Airfares	4	R.Trps	$1,500						$6,000	$6,000
Crew Per Diem	200	mn.dy	$60						$12,000	$12,000
Lodging (Commercial)	2	mo.	$3,500						$7,000	$7,000
FREIGHT										
Air Freight Fairbanks to Venetie	51620	lb.	$1.00						$51,620	$51,620
Truck Freight to Fbks	51620	lb.	$0.10						$5,162	$5,162
TANK FARM SUB TOTAL (RAW COST)				$121,340		1,039		$129,906	$106,782	**$358,028**
Contractor Bond Overhead & Profit	20%	%								$71,606
Project Contigency	15%	%								$53,704
								School District Total Estimated Construction Cost		**$483,338**

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR/ EQUIP	TOTAL COST
40', Class 4 Poles	64	EA	$975	$62,400	8.00	512	$125	$64,000		$126,400
35', Class 4 Poles	23	EA	$775	$17,825	8.00	184	$125	$23,000		$40,825
Anchors RUS Construction	50	EA	$100	$5,000	4.00	200	$125	$25,000		$30,000
E1.11L Guy	50	EA	$75	$3,750	1.00	50	$125	$6,250		$10,000
Sidewalk Guy	2	EA	$75	$150	1.00	2	$125	$250		$400
3-Phase Gang Op. Switch	3	EA	$4,400	$13,200	24.00	72	$125	$9,000		$22,200
C1.11 RUS Construction	26	EA	$200	$5,200	4.00	104	$125	$13,000		$18,200
C2.21 RUS Construction	2	EA	$250	$500	6.00	12	$125	$1,500		$2,000
C2.52 RUS Construction	2	EA	$250	$500	6.00	12	$125	$1,500		$2,000
C5.21 RUS Construction	20	EA	$400	$8,000	8.00	160	$125	$20,000		$28,000
A2.1 RUS Construction	4	EA	$50	$200	1.00	4	$125	$500		$700
A2.3 RUS Construction	8	EA	$50	$400	1.00	8	$125	$1,000		$1,400
A5.1 RUS Construction	18	EA	$50	$900	1.00	18	$125	$2,250		$3,150
N5.1 RUS Construction	145	EA	$25	$3,625	1.00	145	$125	$18,125		$21,750
UC2 Underground riser	1	EA	$800	$800	8.00	8	$125	$1,000		$1,800
Primary Conductor #2 ACSR	38295	LF	$0.40	$15,318	0.015	574	$125	$71,803		$87,121
Secondary Conductor #2/0 Quadplex	120	LF	$6.50	$780	0.010	1	$125	$150		$930
Secondary Conductor #2/0 Triplex	3330	LF	$4.50	$14,985	0.010	33	$125	$4,163		$19,148
Secondary Conductor #2 Triplex	29985	LF	$3.00	$89,955	0.010	300	$125	$37,481		$127,436
10 kVA Transformers	3	EA	$1,000	$3,000	4.00	12	$125	$1,500		$4,500
15 kVA Transformers	16	EA	$1,100	$17,600	4.00	64	$125	$8,000		$25,600
25 kVA Transformers	12	EA	$1,200	$14,400	4.00	48	$125	$6,000		$20,400
Connect to Existing Service	76	EA	$20	$1,520	1.00	76	$125	$9,500		$11,020
Street Lights	25	EA	$425	$10,625	1.50	38	$125	$4,688		$15,313
Demolition of Existing Overhead	1	lump	$0	$0	376	376	$125	$47,000		$47,000
Sub Total Distributionl				**$290,633**		**3013**		**$376,659**	**$0**	**$667,292**
Air Mobilization Fairbanks to Venetie	152,576	lbs	$1.00			120	$100	$12,000	$152,576	$164,576
Misc.Small Freight	1	lump	$10,000						$10,000	$10,000
Rent/Rent Heavy Equip	1	lump				200	$125	$25,000	$75,000	$100,000
Rent Pickup Truck	3	month							$3,000	$3,000
Project Diesel Fuel/Gasoline/Consumables	1	lump	$20,000						$20,000	$20,000
Survey Staking Crew	1	lump	$25,000					$25,000		$25,000
Superintendent Overhead	1	lump			1	120	$125	$15,000		$15,000

Crew Travel Time	1	lump			1	100	$125	$12,500		$12,500
Crew Airfares	10	trips	$2,500						$25,000	$25,000
Crew Per Diem @$60/day	355	mn.dy							$21,320	$21,320
Lodging (Commercial)	4	mn.dy	$3,500						$14,000	$14,000
Job Mob & Demob	1	lump	$25,000						$25,000	$25,000
O&M and Office Supplies	1	lump	$3,000						$3,000	$3,000
Distribution Upgrade Construction Sub-Total				**$290,633**		**3,553**		**$466,159**	**$348,895**	**$1,105,688**
Contractor Bond Overhead & Profit	20%	%								$221,138
Project Contigency	15%	%								$165,853
									Distribution Total Estimated Construction Cost	**$1,492,678**

Appendix C

Electrical Load Data

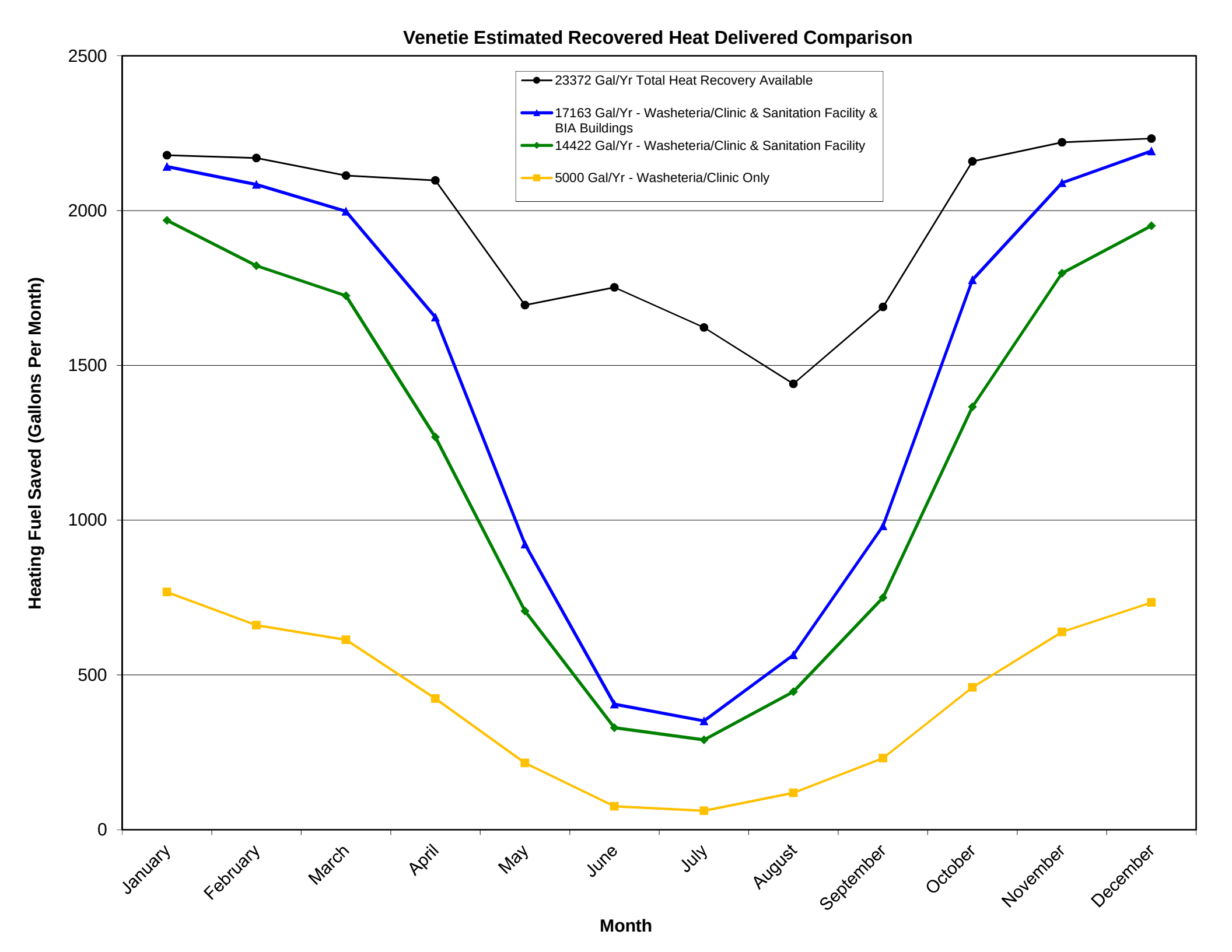
Community Name: Venetie PCE
Community Code: 332880
Fiscal Year: 2015 thru 2021

			Generation Data			Fuel & Non-Fuel Expenses			
Fiscal Year	**Posting Description**	**Month**	**Diesel kWh Generated**	**Total kWh Generated**	**Total kWh Available**	**RCA Calculated Fuel Price**	**Fuel Used (Gallons)**	**Fuel Cost**	**Fuel Efficiency**
15225003									
	Venetie PCE-JUL 14	July	43,600	43,600	43,600	$5.58	5,063	$28,248.00	8.61
	Venetie PCE - AUG 14	August	31,800	31,800	31,800	$5.58	4,355	$24,297.85	7.30
	Venetie PCE -SEPT 14	September	44,700	44,700	44,700	$5.58	5,189	$28,950.99	8.61
	Venetie PCE - OCT 14	October	46,800	46,800	46,800	$5.58	5,112	$28,521.38	9.15
	Venetie PCE - November 2014	November	49,200	49,200	49,200	$5.39	5,060	$27,261.26	9.72
	Venetie PCE - December 2014	December	61,300	61,300	61,300	$5.39	7,245	$39,033.16	8.46
	Venetie PCE - JAN 2015	January	58,700	58,700	58,700	$5.39	5,536	$29,825.75	10.60
	Venetie PCE - FEB 2015	February	54,500	54,500	54,500	$5.39	5,629	$30,326.80	9.68
	Venetie PCE - MARCH 2015	March	51,900	51,900	51,900	$4.93	4,945	$24,380.33	10.50
	Venetie PCE - APRIL 2015	April	67,700	67,700	67,700	$4.93	7,415	$36,558.17	9.13
	Venetie PCE - MAY 2015	May	42,100	42,100	42,100	$4.66	4,624	$21,568.65	9.10
	Venetie PCE - JUNE 2015	June	40,400	40,400	40,400	$4.66	5,322	$24,824.47	7.59
			592,700	592,700	592,700	$5.25	65,495	$343,796.81	9.05
16225003									
	Venetie PCE - JULY 2015	July	46,000	46,000	46,000	$4.66	4,863	$22,683.46	9.46
	Venetie PCE - AUGUST 2015	August	43,300	43,300	43,300	$4.66	6,723	$31,359.43	6.44
	Venetie PCE - SEPTEMBER 2015	September	40,600	40,600	40,600	$4.66	5,872	$27,389.94	6.91
	Venetie PCE - OCTOBER 2015	October	70,300	70,300	70,300	$4.74	5,872	$27,845.02	11.97
	Venetie PCE - NOVEMBER 2015	November	68,100	68,100	68,100	$4.74	11,218	$53,195.76	6.07
	Venetie PCE - DECEMBER 2015	December	54,800	54,800	54,800	$4.05	5,299	$21,436.04	10.34
	Venetie PCE - JANUARY 2016	January	82,900	82,900	82,900	$4.05	7,893	$31,929.55	10.50
	Venetie PCE - FEBRUARY 2016	February	59,400	59,400	59,400	$4.05	6,891	$27,876.16	8.62
	Venetie PCE - MARCH 2016	March	62,700	62,700	62,700	$4.01	8,198	$32,854.30	7.65
	Venetie PCE - APRIL 2016	April	58,300	58,300	58,300	$4.01	7,759	$31,094.97	7.51
	Venetie PCE - MAY 2016	May	53,000	53,000	53,000	$4.01	7,588	$30,409.67	6.98
	Venetie PCE - June 2016	June	43,800	43,800	43,800	$4.01	2,499	$10,014.99	17.53
			683,200	683,200	683,200	$4.30	80,675	$348,089.29	8.47
17225003									
	Venetie PCE - July 2016	July	27,500	27,500	27,500	$3.76	2,704	$10,176.23	10.17
	Venetie PCE - AUGUST 2016	August	44,900	44,900	44,900	$4.12	5,371	$22,148.93	8.36
	Venetie PCE - SEPTEMBER 2016	September	55,400	55,400	55,400	$4.12	3,377	$13,926.07	16.41
	Venetie PCE - OCTOBER 2016	October	80,000	80,000	80,000	$4.12	8,249	$34,017.23	9.70
	Venetie PCE - NOVEMBER 2016	November	89,000	89,000	89,000	$4.12	7,751	$31,963.57	11.48
	Venetie PCE - DECEMBER 2016	December	48,200	48,200	48,200	$3.92	1,942	$7,616.14	24.82
	Venetie PCE - January 2017	January	67,600	67,600	67,600	$3.92	6,595	$25,864.27	10.25
	Venetie PCE - February 2017	February	71,800	71,800	71,800	$3.92	5,842	$22,908.82	12.29
	Venetie PCE - March 2017	March	69,300	69,300	69,300	$3.92	5,271	$20,669.70	13.15
	Venetie PCE - April 2017	April	42,800	42,800	42,800	$3.76	6,726	$25,293.12	6.36
	Venetie PCE - May 2017	May	36,700	36,700	36,700	$3.76	3,819	$14,361.35	9.61
	Venetie PCE - June 2017	June	47,000	47,000	47,000	$3.76	4,847	$18,218.90	9.70
			680,200	680,200	680,200	$3.94	62,494	$247,164.33	10.88

Fiscal Year	Posting Description	Month	Diesel kWh Generated	Total kWh Generated	Total kWh Available	RCA Calculated Fuel Price	Fuel Used (Gallons)	Fuel Cost	Fuel Efficiency
18225003									
	Venetie PCE - July 2017	July	50,800	50,800	50,800	$3.76	5,422	$20,380.21	9.37
	Venetie PCE-August 2017	August	31,200	31,200	31,200	$3.67	5,166	$18,957.15	6.04
	Venetie PCE-September 2017	September	80,200	80,200	80,200	$3.67	5,781	$21,213.96	13.87
	Venetie PCE-October 2017	October	54,300	54,300	54,300	$3.67	6,081	$22,314.84	8.93
	Venetie PCE - December 2017	December	59,120	59,120	59,120	$4.06	6,159	$25,008.62	9.60
	Venetie PCE-January 2018	January	74,780	74,780	74,780	$4.06	7,631	$0.00	9.80
	Venetie PCE-Feb 2018	February	65,775	65,775	65,775	$4.20	5,969	$0.00	11.02
	Venetie PCE-March 2018	March	60,200	60,200	60,200	$4.20	6,491	$27,265.45	9.27
	Venetie PCE-April 2018	April	73,300	73,300	73,300	$4.20	5,998	$25,194.60	12.22
	Venetie PCE-May 2018	May	50,500	50,500	50,500	$4.20	5,449	$22,888.52	9.27
	Venetie PCE-June 2018	June	39,100	39,100	39,100	$4.32	4,712	$20,342.18	8.30
			639,275	639,275	639,275	$4.00	64,859	$203,565.53	9.86
19225003									
	Venetie PCE-July 2018	July	50,800	50,800	50,800	$4.32	4,378	$18,900.26	11.60
	Venetie PCE-August 2018	August	45,900	45,900	45,900	$4.32	4,399	$18,990.92	10.43
	Venetie PCE-September 2018	September	53,000	53,000	53,000	$4.32	6,149	$26,545.85	8.62
	Venetie PCE-October 2018	October	72,000	72,000	72,000	$4.58	9,664	$44,233.09	7.45
	Venetie PCE-November 2018	November	64,100	64,100	64,100	$4.58	14,112	$64,592.04	4.54
	Venetie PCE-December 2018	December	69,900	69,900	69,900	$4.60	8,996	$41,362.71	7.77
	Venetie PCE-January 2019	January	58,500	58,500	58,500	$4.31	8,936	$38,537.39	6.55
	Venetie PCE-February 2019	February	77,400	77,400	77,400	$4.60	5,513	$25,348.22	14.04
	Venetie PCE-March 2019	March	62,200	62,200	62,200	$4.60	7,429	$34,157.80	8.37
	Venetie PCE - April 2019	April	69,000	69,000	69,000	$4.21	6,025	$25,347.18	11.45
	Venetie PCE - May 2019	May	53,300	53,300	53,300	$4.21	5,570	$23,432.99	9.57
	Venetie PCE-June 2019	June	54,300	54,300	54,300	$4.53	6,030	$27,317.11	9.00
			730,400	730,400	730,400	$4.43	87,201	$388,765.56	8.38
20225003									
	Venetie PCE-July 2019	July	65,200	65,200	65,200	$4.53	7,593	$34,397.81	8.59
	Venetie PCE-August 2019	August	62,600	62,600	62,600	$4.53	8,664	$39,249.65	7.23
	Venetie PCE-September 2019	September	47,200	47,200	47,200	$4.53	3,749	$16,983.72	12.59
	Venetie PCE-October 2019	October	53,200	53,200	53,200	$4.53	7,088	$32,110.06	7.51
	Venetie PCE - NOVEMBER 2019	November	60,000	60,000	60,000	$4.53	6,960	$31,530.00	8.62
	Venetie PCE - DECEMBER 2019	December	61,400	61,400	61,400	$4.51	7,011	$31,055.22	8.76
	Venetie PCE - JANUARY 2020	January	106,200	106,200	106,200	$4.51	9,194	$41,430.92	11.55
	Venetie PCE - MARCH 2020	March	64,200	64,200	64,200	$4.51	6,845	$30,845.62	9.38
	Venetie PCE-May 2020	May	117,400	117,400	117,400	$4.59	5,360	$24,627.06	21.90
	Venetie PCE-June 2020	June	112,700	112,700	112,700	$3.74	5,360	$20,048.54	21.03
			750,100	750,100	750,100	$4.45	67,824	$302,278.60	11.06

Appendix D

Heat Recovery Data


Venetie Estimated Recovered Heat Delivered Comparison
23372 Gal/Yr Total Heat Recovery Available
17163 Gal/Yr - Washeteria/Clinic & Sanitation Facility & BIA Buildings
14422 Gal/Yr - Washeteria/Clinic & Sanitation Facility
5000 Gal/Yr - Washeteria/Clinic Only
Heating Fuel Saved (Gallons Per Month)
2500
2000
1500
1000
500
0
January
February
March
April
May
June
July
August
September
October
November
December
Month

Venetie Heat Recovery Simulation - Washeteria/Clinic Only

======== ======= ======= ======= ===== ======== ======== ========

				PROGRAM RESULTS:	
Annual O&M cost:	0	$/year.	[	======== ======== ======== ========	]
Cost Estimate		$	[	Savings, year 0, gallons **5000**	]
Fuel heat value	134000	Btu/gall.	[	======== ======== ======== ========	]
Fuel cost	0.00	$/gallon			
Fuel cost escal.	0	/year			
Power increase	0	/year			
Discount rate	0	/year			

GEN DATA: Jacket Water Only

Heat rate at kw-load above	0	3600	Btu/kwh
Heat rate at kw-load above	25	3600	Btu/kwh
Heat rate at kw-load above	50	3600	Btu/kwh
Heat rate at kw-load above	75	3600	Btu/kwh
Heat rate at kw-load above	100	3600	Btu/kwh
Heat rate at kw-load above	125	3600	Btu/kwh
Heat rate at kw-load above	150	3600	Btu/kwh
Heat rate at kw-load above	175	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh

SYSTEM LOSS DATA:

Constant losses:

Plant piping:	5000	Btu/hr.	Piping Mains Insulated
Buried Arctic piping:	5500	Btu/hr.	(300' of 75mm @ 0.14)*(170F-40F); Note 1
Genset Eng. Preheat	10000	Btu/hr.	Preheat 2 offline engines
Total constant:	**20500**	Btu/hr.	

Variable losses:

Plant Heating	50	Btu/hr.xF	Control Room
Exterior piping	64	Btu/hr.xF	Estimate 400' above-grade arctic pipe @ 0.16 BTUH/ft; Note

GENERATION DATA: 07/2018-06/2019		**WEATHER DATA:**
Kwh/month:		**HDD/Month: Bettles**
January	68500	2409
February	67400	2072
March	66200	1925
April	65000	1329
May	53300	676
June	54300	238
July	50800	192
August	45900	373
September	53000	726
October	67000	1442
November	69100	2004
December	69900	2303
	730400	15689

NOTES:

1 300' Existing Buried to Clinic
2 400' Power Plant to Washeteria

BUILDING DATA:

Fuel use, gallons	Seasonal	Non-Seasonal	Boiler Efficiency	Building in use, 1=yes, 0=no													OPER. HDD
Wash_Clini	5000	0	75%	1	1	1	1	1	1	1	1	1	1	1	1	12	15690
	0	0	75%	1	1	1	1	1	1	1	1	1	1	1	1	12	15690
	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887

Venetie Heat Recovery Simulation - Washeteria/Clinic & Sanitation Facility

======== ========= ======== ======== ===== ========= ========= ========= =========

Annual O&M cost:	0	$/year.
Cost Estimate		$
Fuel heat value	134000	Btu/gall.
Fuel cost	0.00	$/gallon
Fuel cost escal.	0	/year
Power increase	0	/year
Discount rate	0	/year

PROGRAM RESULTS:

[========= ========= ========= =========]
[Savings, year 0, gallons **14422**]
[========= ========= ========= =========]

GEN DATA: Jacket Water Only

Heat rate at kw-load above	0	3600	Btu/kwh
Heat rate at kw-load above	25	3600	Btu/kwh
Heat rate at kw-load above	50	3600	Btu/kwh
Heat rate at kw-load above	75	3600	Btu/kwh
Heat rate at kw-load above	100	3600	Btu/kwh
Heat rate at kw-load above	125	3600	Btu/kwh
Heat rate at kw-load above	150	3600	Btu/kwh
Heat rate at kw-load above	175	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh

SYSTEM LOSS DATA:

Constant losses:

Plant piping:	5000	Btu/hr.	Piping Mains Insulated
Buried Arctic piping:	5500	Btu/hr.	(300' of 75mm @ 0.14)*(170F-40F); Note 1
Genset Eng. Preheat	10000	Btu/hr.	Preheat 2 offline engines
Total constant:	**20500**	Btu/hr.	

Variable losses:

Plant Heating	50	Btu/hr.xF	Control Room
Exterior piping	96	Btu/hr.xF	Estimate 600' above-grade arctic pipe @ 0.16 BTUH/ft; Note

GENERATION DATA: 07/2018-06/2019 / **WEATHER DATA:**

Kwh/month:		HDD/Month: Bettles
January	68500	2409
February	67400	2072
March	66200	1925
April	65000	1329
May	53300	676
June	54300	238
July	50800	192
August	45900	373
September	53000	726
October	67000	1442
November	69100	2004
December	69900	2303
	730400	15689

NOTES:

1 300' Existing Buried to Clinic
2 400' Power Plant to Washeteria + 200' to Sanitation

BUILDING DATA:

Fuel use, gallons	Seasonal	Non-Seasonal	Boiler Efficiency	Building in use, 1=yes, 0=no													OPER. HDD
Sanitation F	8500	1500	75%	1	1	1	1	1	1	1	1	1	1	1	1	12	15690
Wash_Clini	5000	0	75%	1	1	1	1	1	1	1	1	1	1	1	1	12	15690
	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887

Venetie Heat Recovery Simulation - Washeteria/Clinic & Sanitation Facility & BIA Buildings

PROGRAM RESULTS:

Annual O&M cost:	0	$/year.	
Cost Estimate		$	
Fuel heat value	134000	Btu/gall.	
Fuel cost	0.00	$/gallon	
Fuel cost escal.	0	/year	
Power increase	0	/year	
Discount rate	0	/year	

[Savings, year 0, gallons **17163**]

GEN DATA: Jacket Water Only

Heat rate at kw-load above	0	3600	Btu/kwh
Heat rate at kw-load above	25	3600	Btu/kwh
Heat rate at kw-load above	50	3600	Btu/kwh
Heat rate at kw-load above	75	3600	Btu/kwh
Heat rate at kw-load above	100	3600	Btu/kwh
Heat rate at kw-load above	125	3600	Btu/kwh
Heat rate at kw-load above	150	3600	Btu/kwh
Heat rate at kw-load above	175	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh
Heat rate at kw-load above	180	3600	Btu/kwh

SYSTEM LOSS DATA:

Constant losses:

Plant piping:	5000	Btu/hr.	Piping Mains Insulated
Buried Arctic piping:	5500	Btu/hr.	(300' of 75mm @ 0.14)*(170F-40F); Note 1
Genset Eng. Preheat	10000	Btu/hr.	Preheat 2 offline engines
Total constant:	**20500**	Btu/hr.	

Variable losses:

Plant Heating	50	Btu/hr.xF	Control Room
Exterior piping	160	Btu/hr.xF	Estimate 1000' above-grade arctic pipe @ 0.16 BTUH/ft; Note

GENERATION DATA: 07/2018-06/2019 / **WEATHER DATA:**

Kwh/month:		HDD/Month: Bettles
January	68500	2409
February	67400	2072
March	66200	1925
April	65000	1329
May	53300	676
June	54300	238
July	50800	192
August	45900	373
September	53000	726
October	67000	1442
November	69100	2004
December	69900	2303
	730400	15689

NOTES:

1 300' Existing Buried to Clinic
2 400' Washeteria + 200' Sanitation + 400' BIA

BUILDING DATA:

Building in use, 1=yes, 0=no

Fuel use, gallons	Seasonal	Non-Seasonal	Boiler Efficiency														OPER. HDD
Washeteria	8500	1500	75%	1	1	1	1	1	1	1	1	1	1	1	1	12	15690
Clinic/Old W	5000	0	75%	1	1	1	1	1	1	1	1	1	1	1	1	12	15690
Trbl Bldgs	5000	0	75%	1	1	1	1	1	1	1	1	1	1	1	1	12	15690
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887
-	0	0	75%	1	1	1	1	1	0	0	0	1	1	1	1	9	14887

Appendix E

Geotechnical Report

December 7, 2020 20148373

Karl Hulse, PE
CRW Engineering Group LLC
3940 Arctic Blvd, Suite 300
Anchorage, AK 99503

GEOTECHNICAL CONSIDERATIONS, RURAL POWER SYSTEM AND BULK FUEL UPGRADES, VENETIE, ALASKA

Karl:

This letter presents the results of our historic geotechnical data review and geotechnical considerations for the Alaska Energy Authority (AEA) planned Rural Power System Upgrade (RPSU) and Bulk Fuel Upgrade (BFU) in Venetie, Alaska. This work has been performed in accordance with our proposal and professional services agreement with CRW Engineering Group LLC (CRW) and consultation with Grey Stassel Engineering (GSE). Our conclusions and recommendations are based primarily on our review of existing geotechnical data for the village.

CRW and select design team members conducted a site reconnaissance at the planned RPSU and BFU locations on October 7, 2020. CRW anticipated advancing a series of shallow exploration test pits at the RPSU and possibly the BFU sites during the site reconnaissance. We understand local excavation equipment was not operational and COVID-19 constraints impacted alternative measures to advance test pits during the site reconnaissance. Per our agreement, we were not authorized to conduct a site and project specific geotechnical investigation to support our conclusions and recommendations.

1.0 PROJECT UNDERSTANDING

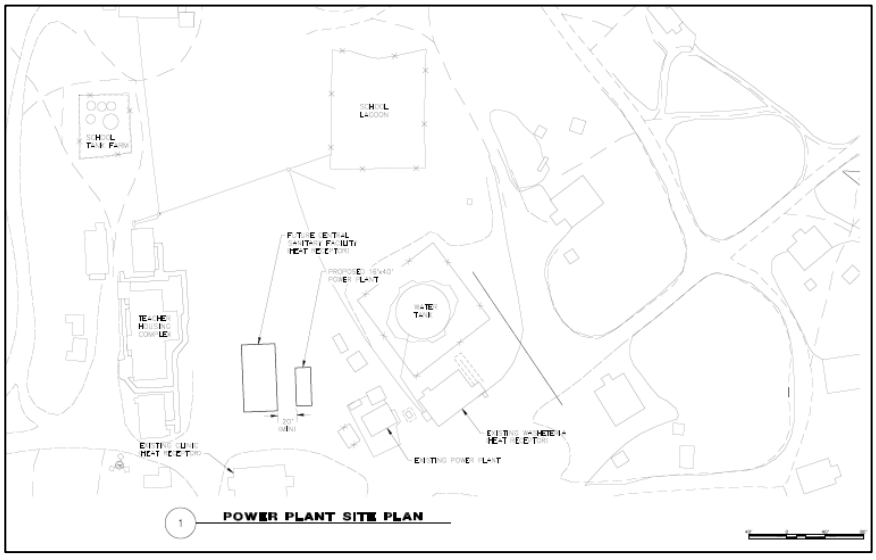
As currently proposed, the development has to primary components:

- RPSU as a new replacement powerplant, expected to be a modular design facility. The currently preferred location for the replacement powerplant is at the central utility core area of the village. Diesel piston generators with associated switch gear and bulk fuel storage will be planned for this replacement power generation system.
- BFU as new above grade fuel storage tanks at the airport apron. The new bulk fuel system is currently planned as two each 8,000-gallon skid mounted double wall tanks for diesel fuel and a single 5,000-gallon skid mounted double walled tank for motor gasoline. New fuel dispensing, fuel headers for air cargo fuel transfer, and new associated piping are planned. A new reinforced and lined truck fuel transfer pad will also be provided adjacent to the new fuel storage tanks.

The approximate locations for the planned upgrades are noted on the following GoogleEarth image. The general locations are considered approximate and may change as additional community input and design planning advances.

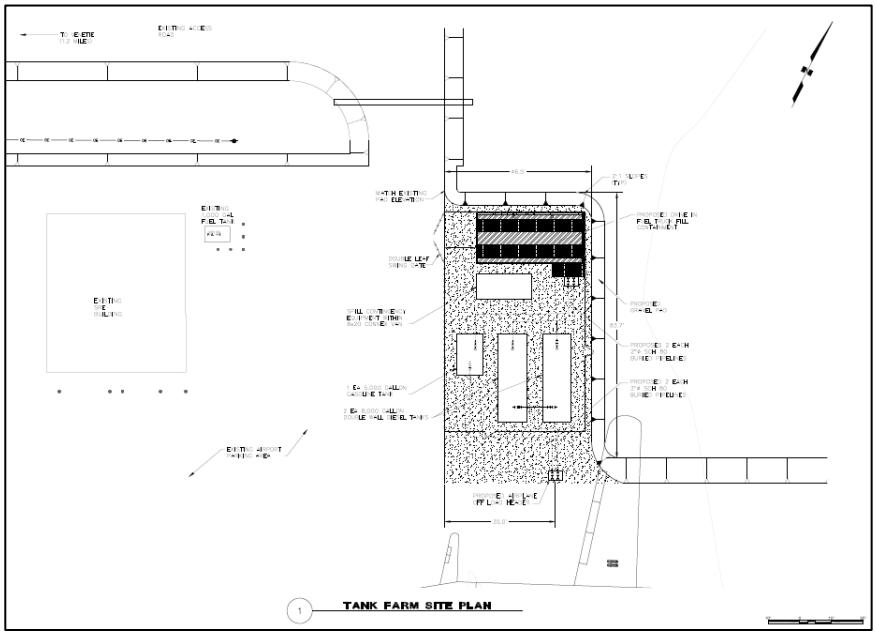
2.0 RPSU AND BFU SITING

Preliminary coordination meetings with village representatives and AEA personnel indicate the currently preferred location for the RPSU is in the general utility development core of the village, near the existing water storage tank. The approximate location for the replacement RPSU was provided by CRW:



The replacement RPSU is expected to be a nominal 16-foot by 40-foot single-story structure. A prefabricated steel module suitable for C130 transport is envisioned. The structure will house a series of reciprocating piston prime mover electric power generators, electric switchgear and operation/maintenance facilities inside a heated building. Fuel storage will be provided from a bulk fuel storage tank adjacent to the powerplant that will be refueled by truck from the primary BFU storage.

The new BFU is planned as an upgraded existing granular fill pad along the eastern side of the airport apron. The approximate location and planned geometry for the BFU is provided in the following conceptual site plan developed by CRW.



3.0 HISTORIC GEOTECHNICAL DATA SUMMARY

Geotechnical data for this analysis were available from the following previous soil explorations in Venetie:

- May 1979: Shannon & Wilson collected information for the design of the Venetie High School. Two exploratory borings, 20- and 25-feet in depth, were drilled at the proposed school site. The borings encountered 2 to 3 feet of surficial silt grading to silty sand, overlying silty, sandy gravel and gravelly, silty sand. Laboratory tests revealed water contents ranging from 3 to 10-percent (dry weight basis) and fines (material passing the US Number 200 standard sieve size) ranging from 18 to 36-percent by dry weight. This indicates these materials were frost susceptible. Seasonally frozen ground was present to depths of 3.5 to 5 feet and permafrost was found at depths of 7 feet in the wooded area to 12 feet below grade at the time of the field effort (bgs) in the cleared area.
- Spring/Summer 1978: Scott Wheaton, Geologist, conducted four subsurface soils investigations for the U.S. Public Health Service examining a total of 9 test pits, 16 test holes, and 10 water well borings to determine the suitability of on-site wastewater disposal throughout the village. He reported a fairly uniform soil sequence underlying the area, finding 5 to 8 feet of silt overlying dry, porous, sandy gravel, underlain by

bedrock encountered at 40 to 70 feet below grade. He observed that the silt and sandy gravel were dry-frozen, containing no pore or visible ice, and that the active layer was about 4 to 6 feet thick at the time of his field efforts.

- March 1985: J. M. Lambe and Associates conducted a subsurface investigation for an addition to the school. Eight borings, ranging from 24.5 to 30.5 feet in depth, were drilled near the proposed site, samples were collected, and laboratory tests performed. The typical soil profile underlying the site, and consistent in all 8 test holes, was of 4 to 7 feet of frozen ice-rich silts, sandy silts, and organic materials underlain by frozen gravel. The moisture contents of gravel samples from one boring indicated that the gravels might be ice-rich in some areas. However, no significant excess ice was observed in any of the recovered samples, and neither massive ice nor thawed zones were encountered. All of the near surface silty soils are frost susceptible and thaw unstable. Down-hole temperatures measured shortly after completion of drilling found an average soil temperature of 29°F (in 1985).
- October 1998: Duane Miller & Associates presented the results of their soils investigation for the Venetie Airport Master Plan. In October 1997, subsurface conditions were documented at 30 locations by logging and sampling drilled borings, shovel excavations, cut banks, and by performing laboratory testing. Soil conditions were found to be uniform on the upper terrace consisting of silty sand and silty gravel overlain by 3 to 6 feet of olive brown silt and a thin organic mat. The silt was determined to be primarily eolian in origin with relatively low natural moisture contents and to be generally free draining when thawed. Permafrost was found to be significantly degraded. Frozen ground was encountered only in several heavily wooded areas and may have been remnant of seasonal frost. Seasonal thaw depths were found to range from 5 to 10 feet bgs. Sand and gravel fill material was found to be locally available. Specific to the 1998 geotechnical findings report, Alternative “C” location appears to be the current airstrip. 1998 test pits VE-13, 17, 18, 24 and 25 were advanced at the Alternative “C” location. These test pits indicated 4 to 5 feet of silt overlying granular soils with variable frozen ground conditions.
- July 2019: HDL Engineering Consultants advanced four shallow test pits to support the foundation design for the current Central Sanitation Facility/Washeteria project for ANTHC. Subsurface conditions were primarily silt with increasing sand and gravel content with depth starting around 10 feet bgs. None of the test pits reported encountering permafrost conditions to the depth of the explorations, about 12 feet bgs.

4.0 GEOLOGIC SETTING

The village of Venetie is located on the north side of the Chandalar River approximately 45 miles northwest of Ft. Yukon and about 45 miles from the confluence of the Chandalar and Yukon Rivers. It is situated in the lowland area known as the Yukon Flats. The village was originally located on a lower geologic terrace immediately adjacent to the river. Flooding concerns resulted in the need for more space and the migration to the higher ground (upper geologic terrace). Most of the public structures and facilities are located on the upper geologic terrace.

Venetie lies near the base of the southern foothills of the Brooks Range. Gravelly glacial outwash from this range forms an alluvial fan underlying the area of the village. On the northeast bank, the river has cut the alluvial deposits to form steep bluffs, rising 30 to 40 feet above the floodplain to a generally flat terrace (upper geologic terrace). The upper geologic terrace is generally composed of alluvial granular material, primarily sand and gravel with varying amounts of fines. The granular material is overlain by 3 to 5 feet of eolian (wind blown) silt and a thin

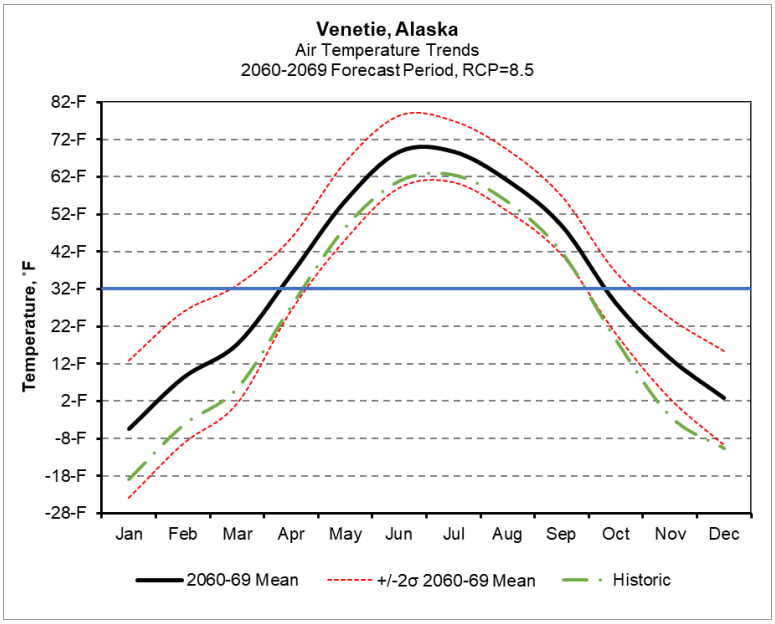
organic mat of forest duff and moss. However, thicker silt deposits are reported in the planned RPSU development area, up to 10 feet thick, before encountering soils with increased sand and gravel.

Degraded permafrost conditions are inferred from the reviewed geotechnical data. In additional variable thickness surface organics are reported throughout the area but in general, surface organics are generally absent below 3 to 5 feet bgs.

5.0 ENGINEERING CLIMATE CONSIDERATIONS

Forecast air temperature trends were developed for the 2060-2069 period based on publicly available data developed by the University of Alaska Fairbanks, Scenarios Network for Alaska & Arctic Planning (SNAP) group. The SNAP group uses five Intergovernmental Panel on Climate Change (IPCC) General Circulation Models (GCM) they consider most applicable for Alaska. SNAP includes several Representative Concentration Pathways (RCP) for their climate forecasts. For our analysis, we used an RCP of 8.5 (watts/m^2) to estimate monthly average air temperatures for select forecast periods.

The forecast climate model analysis results have variability. SNAP forecast data include the five GCM model average as well as a two standard deviation spread for the selected forecast period.



As noted above, continued air temperature warming is anticipated for the Venetie area through at least the 2060-2069 forecast period used for our analysis. For the 2060-2069 forecast period the mean annual air temperature is forecast to warm with the colder range (two standard deviations below the forecast period mean) roughly similar to historic air temperature trends. If correct, these data indicate continued degradation permafrost can occur with deepening surface thaw and warming of the permafrost at depth throughout the area. Additional ground thermal impacts may occur due to localized drainage impacts, snow drifts, and surface disturbance from site or nearby development. Vegetation changes are also anticipated in response to the increasing warming trends.

For our engineering analysis, the key climate parameters derived from the SNAP data for Venetie include Freezing Index (FI) and Thawing Index (TI), both as cumulate °F-days for each based on monthly average air temperature data. Summarized below are the SNAP derived approximate FI and TI data for the 1961-1990 historic and the 2060-2069 forecast period. As noted below, a general warming trend should be expected for the area over the project's anticipated service life.

Period		Average Air Temperature	Freeze Index	Thaw Index
1961-1990	Mean	23.6 F	6,330 F-days	3,400 F-days
2060-2069	5 Model Mean	33.6 F	3,860 F-days	4,500 F-days
2060-2069	Mean +2σ	45.1 F	1,500 F-days	6,330 F-days
2060-2069	Mean -2σ	22.1 F	6,550 F-days	3,020 F-days

Historically, precipitation in the area averages less than ten inches per year. The average snowfall is 3.5 to 4 feet, and cold temperatures and moderate winter winds result in large accumulations of snow. The prevailing winds are generally out of the northeast during winter and from the southwest during the summer.

6.0 GEOTECHNICAL SEISMIC CONSIDERATIONS

Based on our interpretation of the subsurface conditions encountered at this site and the general geology of the project area, we recommend soil Site Class "D" be applied for the planned developments (RPSU and BFU sites). Seismic ground motion parameters for this site were developed based, in part, on the 2012 IBC, summarized below. The structural engineer, in conjunction with the design team, should determine the appropriate occupancy classifications to develop the appropriate seismic response parameters for these structures.

Seismic Parameter	2012 IBC Reference
Short Period Spectral Acceleration (S_S)	0.555g
1-second Period Spectral Acceleration (S_1)	0.209g
Site Amplification Coefficient (F_a) for Soil Site Class "D"	1.356
Site Amplification Coefficient (F_v) for Soil Site Class "D"	1.982
Short Period Spectral Response Acceleration (S_{MS})	0.753g
1-second Period Spectral Response Acceleration (S_{M1})	0.415g
PGA_M	0.232g

Determined for coordinates 67.0148°N, 146.4168°W, Class I/II/III Risk Category

The site may be underlain with saturated sands with variable fines and gravel content with the potential for soil liquefaction under specific seismic conditions. Our recommendations do not include soil liquefaction mitigation measures. If a refined geohazard risk evaluation for seismic hazards at this site is warranted, a more detailed geotechnical investigation program will be required.

7.0 DISCUSSION

Based on the review of existing soils data and the relatively uniform conditions reported in the historic geotechnical data encountered throughout the village, we expect generally similar conditions at both the RPSU and BFU sites. However, at the RPSU site a thicker sequence of silty soil, approximately 10 feet thick, overlying the increasing sand and gravel layer is expected. In general, a thin surface organic layer is expected to be present but with the potential for peat sequences under the surface organics. The organic mat may be disturbed at some locations or covered with fill both sites, especially at the BFU site.

Silt is expected to underlie the surface organic layer with mineral silts expected below 3 to 5 feet bgs. The silt is expected to have moderate strength when it is unfrozen but it is highly frost susceptible. The silt should be expected to experience shear strength loss during thaw each summer. As noted above, sandy gravel with variable fines content is present under the village starting at depths of 3 to 10 feet bgs and extends to depths of 30 feet bgs, or more based on our review of historic geotechnical data.

In its natural state, the entire area away from the river thaw bulb was probably underlain by permafrost. Seasonal thaw depths probably ranged from about 5 to 10 feet bgs on the silt-covered terrace. Continued human activity in the area has altered the surface cover (albedo) resulting in continued permafrost degradation. It is reasonable to expect deeper thaw penetration at the proposed BFU area if fill is present and rigid insulation was not used in the fill section. However, bonded permafrost with variable ice contents can be expected at both planned development areas.

In general, the mineral silt is expected to provide adequate load bearing for the planned developments provided a structural fill section is placed over the mineral silt. To control settlements, all organic material and ice-rich soils should be removed under all load bearing and settlement intolerant areas for the planned developments.

The mineral silt is considered highly frost susceptible. Structure foundations, skid mounted fuel tanks, and the planned concrete truck fuel transfer pad should include frost protection measures to reduce the risk of seasonal frost related differential movements. If permafrost is present, it is expected to degrade in response to the planned site developments and longer-term climate warming trends. Permafrost degradation could result in thaw-related settlement reflected at the ground surface. Provisions for releveling the structures, bulk fuel tanks and piping, and settlement intolerant facilities should be integral to the design.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 RPSU Site

Based on our discussions with the design team, we understand a shallow foundations as isolated pads are preferred for the structure's foundation system. The pads will be either precast or cast-in-place concrete. A relatively thin clear space between the base of the heated structure and finish grade is planned but conductive heat transfer from the building envelop through the foundations is expected. A slab-on-grade design is not currently envisioned for the RPSU facility.

Based on our review of the historic geotechnical data in the general area of the planned RPSU development, the site is considered suitable for the proposed development using shallow foundations that bear on imported structural fill placed on the conditioned in-place mineral silt. Our geotechnical recommendations are based, in part, on the foundations not being subjected to cyclic vibratory or machine loading states. If the building loads or

prime movers are expected to impose vibratory or machine loads on the foundations, we must be contacted to review our recommendations presented herein.

The overlying unclassified fill, organics, and silty soil should be removed to at least three (3) feet below the base of the shallow foundation pads. The exposed in-place mineral silt should be fully thawed, moisture conditioned, scarified 6 to 8-inches deep and proof compacted to at least 95-percent of the material's maximum dry density as determined by the modified Proctor method, ASTM D-1557. A non-woven geotextile similar to Geotex 801 should be placed over the prepared in-place silt prior to structural fill placement.

Vibratory soil compaction methods are recommended but caution is recommended if the moisture contents of the silt are above optimum. The exposed mineral silt are considered highly moisture sensitive and can lose significant shear strength if disturbed above their optimal soil moisture range. Regaining shear strength of the disturbed silt on the wet side of its optimum moisture content can be challenging and may result in the need for dewatering, overexcavation, or other soil shear strength improvement methods.

Structural fill should be well-graded sand and gravel that meets the US Army Corps of Engineers Non-Frost Susceptible (NFS) classification. For this project, we recommend all structural fill pass a nominal 4-inch dimension. All structural fill should be moisture conditioned, fully thawed and placed in nominal 12-inch thick lifts then densified using mechanical compaction methods as recommended for proof compacting.

The RPSU modular design concept is expected to use an isolated, reinforced concrete square pad foundation system bearing on structural. We have assumed the foundation pads will be unheated. For all loading cases, the foundation pads should be between 3 to 5 feet square (9 to 25 square feet). If isolated foundation pads less than 9 or greater than 25 square feet we must be notified to review our recommendations.

For geotechnical purposes, we have assumed the isolated pads will be approximately 24-inches thick. The civil and structural engineer will develop isolated pad dimensions and geometry. The top of the isolated pads should be elevated approximately 5 inches above finish grade or as recommended by the civil and structural engineer. A minimum 8-inch high clear space between the base of the module and finish grade is recommended to allow for drainage and seasonal frost movement within the fill under the module.

A rigid insulation layer is recommended in the structural fill under the RPSU building foundations as a frost protection measure. The rigid insulation should be located over approximately two feet of structural fill and allow for a nominal 6-inch thick structural fill section between the base of the foundation pad and the top of the rigid insulation layer.

The rigid insulation should be at least 4-inches thick and extend at least five (5) feet horizontally in all directions from the foundation pad perimeter. The rigid insulation be provided in 2-inch thick boardstock and placed with offset vertical joints. A fuel resistant liner is recommended over the rigid insulation that extends at least two (2) feet beyond the perimeter of the rigid insulation. We should review the final foundation frost protection measures during the design phase.

Rigid insulation should be an extruded or expanded polystyrene material with a minimum rated compressive strength of 40 pounds per square inch (psi) at no more than 10-percent strain. If so, the foundation pads can be designed for an allowable bearing pressure of 1,500 pounds per square foot (psf). If a rigid insulation with a rated compressive strength of 60-psi is used under the foundation pads, an allowable bearing pressure of 2,500-psf can

be used. For all cases, a one-third increase in the allowable bearing pressure is permitted for short-term transient load states.

Structural fill should be placed above the rigid insulation layer to the finish grades developed by the civil engineer. Final grades should direct surface water away from the structure. Depending on the nature of the structural fill, additional armor material may be warranted along building driplines to reduce pad fill erosion.

Appurtenances attached to the building exterior should be designed to permit seasonal frost movements and differential settlement. Flexible connections and allowances for seasonal vertical and horizontal movements that will not result in damage are advised.

Lateral resistance can be developed as base friction between the cast-in-place concrete foundations and the underlying structural fill. A frictional resistance of 0.4 can be applied at the concrete foundation/structural fill contact provided the structure's dead load is used to determine lateral resistance. In addition, passive resistance can be developed along the vertical foundation faces using an equivalent fluid approach. For this case, an active and passive equivalent fluid pressure of 30*H and 200*H pounds per cubic foot (pcf), respectively, can be applied. For each case "H" is the vertical foundation face height in feet, with the uppermost one foot below finish grade ignored for the passive case.

Backfill along posts or stem walls (if used) should be placed and compacted as recommended for structural fill in a balanced manner to reduce lateral stresses along subgrade walls during construction. If retaining walls are planned for the development, we should be contacted to provide geotechnical guidance and recommendations.

If the site is prepared per our recommendations and the foundations placed in accordance with the design team's recommendations, a total settlement of 1-inch, differential of 0.75-inch is expected, in addition to any longer-term settlement related to permafrost degradation. However, if machine or cyclic loads are imposed on the foundations from the building or prime movers, a reduced allowable bearing capacity and/or increased settlements should be expected. We must be contacted if cyclic vibratory or machine loads are anticipated.

8.2 BFU Site

As currently envisioned, the BFU development includes two key elements; (1) new above grade, skid mounted bulk fuel storage tanks and (2) a reinforced concrete truck fuel transfer pad. The area for the planned development appears to have an unclassified fill pad of undetermined site preparation, geometry, and material properties. We recommend either (1) site exploration (test pits) to verify conditions at this site or (2) removal and segregation of the placed fill material for possible reuse and site preparation per our recommendations below.

8.2.1 Bulk Fuel Storage Area

The double-walled fuel tanks will be founded on skids that will bear on the structural fill surface. The bulk fuel storage is expected to be unheated. The skid-supported tanks will move vertically as the underlying mineral silt and possibly the structural fill freezes and thaws each year. Consequently, flexible connections should be included in the piping between the tanks and the supply lines. Vertical ground movements could be on the order of 3 to 6 inches.

If differential movements related to seasonal frost and/or permafrost degradation can be tolerated, the bulk fuel tanks can be seated on a nominal three foot thick structural fill pad placed over firm, non-compressible mineral silt as recommended for the above RPSU site preparation, including a geotextile separation between the prepared

silts and structural fill. However, this approach should be expected to require periodic tank releveling. If seasonal differential movements cannot be tolerated, overexcavation of the organic and mineral silts to thaw stable sand and gravel with structural fill material backfill is recommended.

The surface organic layer is expected to be relatively thin, generally less than 6 inches thick, but some thicker peat layers may be present. The organic layer could be removed and then replaced with structural fill. We do not envision the need for rigid insulation and fuel resistant liners in the planned bulk fuel storage area if differential movements and periodic releveling is acceptable.

8.2.2 Concrete Truck Fuel Transfer Pad

We have assumed the concrete slab for the truck fuel transfer facility will be unheated but will be relatively intolerant to differential movements. Accordingly, we recommend removal of all existing pad fill, organics, and compressible silts below the pad footprint and replacement with structural fill. Excavation should extend to in-place mineral granular soil. Use of a rigid insulation layer with a top fuel resistant liner is advised to reduce the longer-term risk of permafrost degradation and seasonal frost related movement. Site preparation, structural fill placement, and rigid insulation recommendations similar to the RPSU are recommended for the concrete truck fuel transfer pad

9.0 CONSTRUCTABILITY CONSIDERATIONS

Select construction-phase considerations related to earthwork and foundation elements include:

- Test pits to confirm our geotechnical assumptions are advised at both the RPSU and BFU locations.
- The site preparation and structural fill placement should be observed by an experienced member of the design team.
- Seasonal fluctuations in the groundwater elevations should be expected, particularly during periods of prolonged precipitation. Construction phase dewatering may be required to achieve our recommended site preparation and foundation placement. If so, dewatering is considered the responsibility of the contractor and all required permits and monitoring should be conducted by the appropriate personnel.
- All finish grades should direct surface water away from the structures, including finish grades under the RPSU module.
- Roof drainages should consider armored material along their drip lines and channeled roof drainages should direct water away from the foundations.
- The contractor will be responsible for all construction-phase site safety including excavation sidewall stability.

10.0 USE OF REPORT

The summary geotechnical findings and recommendations presented herein were prepared for CRW and GSE and their design team members for use in the planning and design of the proposed replacement RPSU and BFU facilities in Venetie, Alaska. The geotechnical recommendations were developed based solely on review of historic geotechnical data. As such, all reviewers and users of this submittal must understand and accept the risks inherent with reliance solely on historic geotechnical data, particularly older data that may not reflect current

ground thermal regime states. We will need to review the design plans and specifications as they are developed for conformance with our geotechnical recommendations provided with this submittal.

If there are significant changes in the nature, design, or location of the facilities, we should be notified so that we may review our conclusions and recommendations with consideration of the proposed changes and provide a written modification or verification of the changes.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by a limited number of explorations or soil samples. Such unexpected conditions frequently result in additional project costs to build the project as designed. Therefore, a contingency for unanticipated conditions should be included in the construction budget and schedule. We consider this particularly critical for projects designed without site and project specific geotechnical investigations

The work program followed the standard of care expected of professionals undertaking similar work in Alaska under similar conditions. No warranty expressed or implied is made.

11.0 CLOSURE

We appreciate the opportunity to provide work on this project. Please contact Richard Mitchells at 907-865-2537 if you have questions or comments.

Golder Associates Inc.

draft submittal for client review, no signature

Richard Mitchells, PE
Principal

Attachments: none provided with this submittal